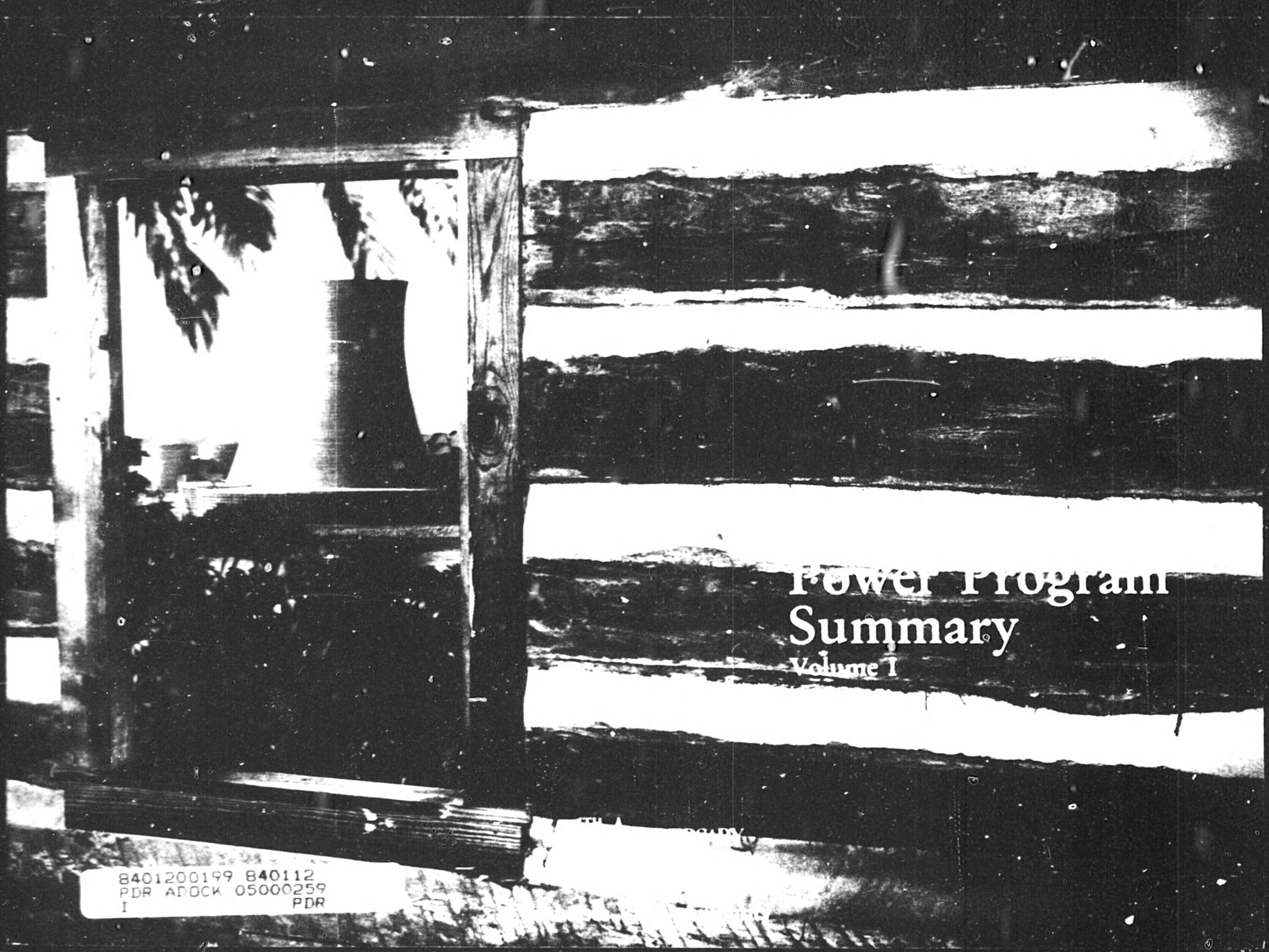

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1982 Power Program Summary

1982 Power Program Summary
Volume I

For the fiscal year ended September 30, 1982
Tennessee Valley Authority
A corporation wholly owned by the United States of America

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 distributors and one privately owned electric system which in turn distribute power to nearly 2.9 million customers in parts of seven States. TVA also supplies power directly to 50 industrial customers with large or unusual power requirements and several Federal, nuclear, aerospace, and military installations.

Financially, the Power program is separate from other TVA programs. 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 Energy Regulatory 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.

This report, published in two volumes, provides a summary of TVA power and distribution operations in fiscal year 1982. Volume I data is based on the TVA fiscal year ending September 30, 1982, unless otherwise noted. Volume II data is based on the distributors' fiscal year ending June 30, 1982.

Board of Directors
Charles H. Dean, Jr., Chairman
S. David Freeman, Director
Richard M. Freeman, Director
General Manager
William F. Willis
Manager of Power
Hugh G. Parris
General Counsel
Herbert S. Sanger, Jr.
Comptroller
Robert L. Yates

Cover

A weatherbeaten symbol of the pre-TVA days looks out on the agency's newest power source, Sequoyah Nuclear Plant. Unit 2 began commercial generation in June 1982, and the two units together produced nearly 10 billion kilowatthours of power during 1982.

Contents

Statistical Summary

	Fiscal Year 1982	Fiscal Year 1981
Sales (billion kWh)**	109	115
Revenues (millions)	$ 3,982	$ 3,780
Payments in Lieu of Taxes to States and Counties (millions)	$ 163	$ 137
Total Operating Expenses (millions)	$ 2,461	$ 2,590
Net Interest Charges (millions)	$ 872	$ 995
Net Income or Loss* (millions)	$ 390	$ 216*
Increase or Decrease* in Retained Earnings (millions)	$ 281	$ 302*
Total Payments to U.S. Treasury (millions)	$ 129	$ 106
Total Assets (millions)	$17,736	$15,648
Average Annual Residential Use (kWh)	13,760	14,250
Average Cost per Residential Kilowatthour (cents)	4.62	4.07

*Deduct - After the $400 million provision for loss on deferred nuclear construction (See note 3 "Notes to Financial Statements")

**Represents total TVA sales at the delivery point to distributors, industries, and Federal agencies. The 1982 total sales to ultimate customers is 104 billion kWh. For 1981 total sales to ultimate customers was 110 billion kWh. The difference between TVA sales and sales to ultimate customers is the power lost in distribution facilities.

TVA/OP/PINF-83/5
TVA is an equal opportunity employer and is committed to ensuring that the benefits of programs receiving TVA financial assistance are available to all eligible persons regardless of race, color, national origin, handicap, or age.

"In 1982 we dealt with four issues: One—our market had changed drastically. Two—it was not possible to 'produce' our way out of the problem as we had in the past. Three—it would be possible to fail if we could not change to meet our market conditions. Four—we could change successfully.

"Item four is the consequential one. We changed significantly in 1982 to match our market."

H. G. Parris
Manager of Power

Viewpoint

The year 1982 has been a turning point for the Office of Power and for TVA. We have recognized for some time a critical, fundamental change in the electric utility industry. We have now been able to quantify the problem and therefore effect a timely response. The challenge has been to match our levels of activity to a new market outlook for electric energy. And the results have been most gratifying.

To understand the significance of the action taken in 1982, it is necessary to review the fundamental changes in the electric utility industry.

Through the early 1970s, TVA power sales were growing at a rate of about seven percent a year. We had enjoyed the benefits of significant technological advancement in the 1950s and 1960s with the development of the large central generating units. New capacity had been brought online, producing power at lower unit costs than previous units. And there was a hungry market for power developing right along with the industry when TVA was planning the construction of nuclear power projects in the late 1960s and early 1970s.

By the early 1970s, the utility industry had essentially reached a plateau in major technological development, and in the mid- to late-1970s, costs were rising rapidly. Coal which was $6.51 a ton in 1972 was $41.34 a ton by 1982. And TVA, one of the Nation's largest coal buyers, burned 28.8 million tons in 1982.

Inflation, rising interest rates, regulatory changes, new environmental rules, and construction delays took a drastic toll on construction costs. While we had planned in the late 1960s to bring Browns Ferry Nuclear Plant online at $123 per kilowatt, it actually came online in 1974 at $284 per kilowatt. The first unit at Sequoyah Nuclear Plant came online in 1981 at $919 per kilowatt. Interest expense, mainly to support the construction program, began to rival coal as the largest budget item.

While remaining below the national averages, the cost of power to consumers began to climb as well. The average cost per residential kilowatthour rose from 1.3 cents in 1972 to 4.6 cents in 1982. The average cost per kilowatthour sold to large industries rose from 0.6 cents in 1972 to 4.1 cents in 1982.

In 1982 we dealt with four issues:

1. Our market had changed drastically.
2. It was not possible to "produce" our way out of the problem as we had in the past.
3. It would be possible to fail if we could not change to meet our market conditions.
4. We could change successfully.

Item four is the consequential one. We changed significantly in 1982 to match our market.

In some cases it was through increased emphasis on existing programs such as the recognition of energy conservation as a viable economical alternative to increasingly expensive capital expansion. Our conservation programs to date are saving the use of approximately 1.4 billion kilowatthours annually for over 330,000 residential, commercial, and industrial consumers.

In other cases unprecedented action was required, such as the scaling back of our nuclear construction program, resulting in four nuclear generating units being cancelled and four units in deferred status.

Cancellation of four units brought our construction more in line with new, lower sales projections. And the cancellation will provide a net saving to consumers of about $265 million over the next 10 years and $546 million over the next 20 years, compared to what costs would have been if we had continued to build. Electric rates are lower today—and will be in the future—than they would be without this action.

Power people at every level have been involved in the efforts to hold the line on costs and to match Power activities to the market. Some moves have been painful. The Power work force was cut by 2,000 employees. In monthly top management meetings, we have focused on financial and budgetary concerns.

Recent gains have returned us to the top ranks of U.S. electric utilities in the area of heat rate, the efficiency with which coal is turned into electric energy. In 1982 alone the effort saved TVA consumers about $12 million in fuel costs.

We have worked to continue a strong rapport with our local partners, the municipal and cooperative distributors of power, to support their efforts to provide improved service for consumers.

In spite of a record sales drop, we experienced strong financial performance. Because of some rather bold action in cancelling and deferring nuclear units and good performance in operating and maintenance, we were able to declare $184 million in revenue credits for 1983 and to close out the year recommending a net effective increase in retail power bills of only 4.4 percent for fiscal year 1983.

Hugh G. Parris

Financial Analysis

Sales

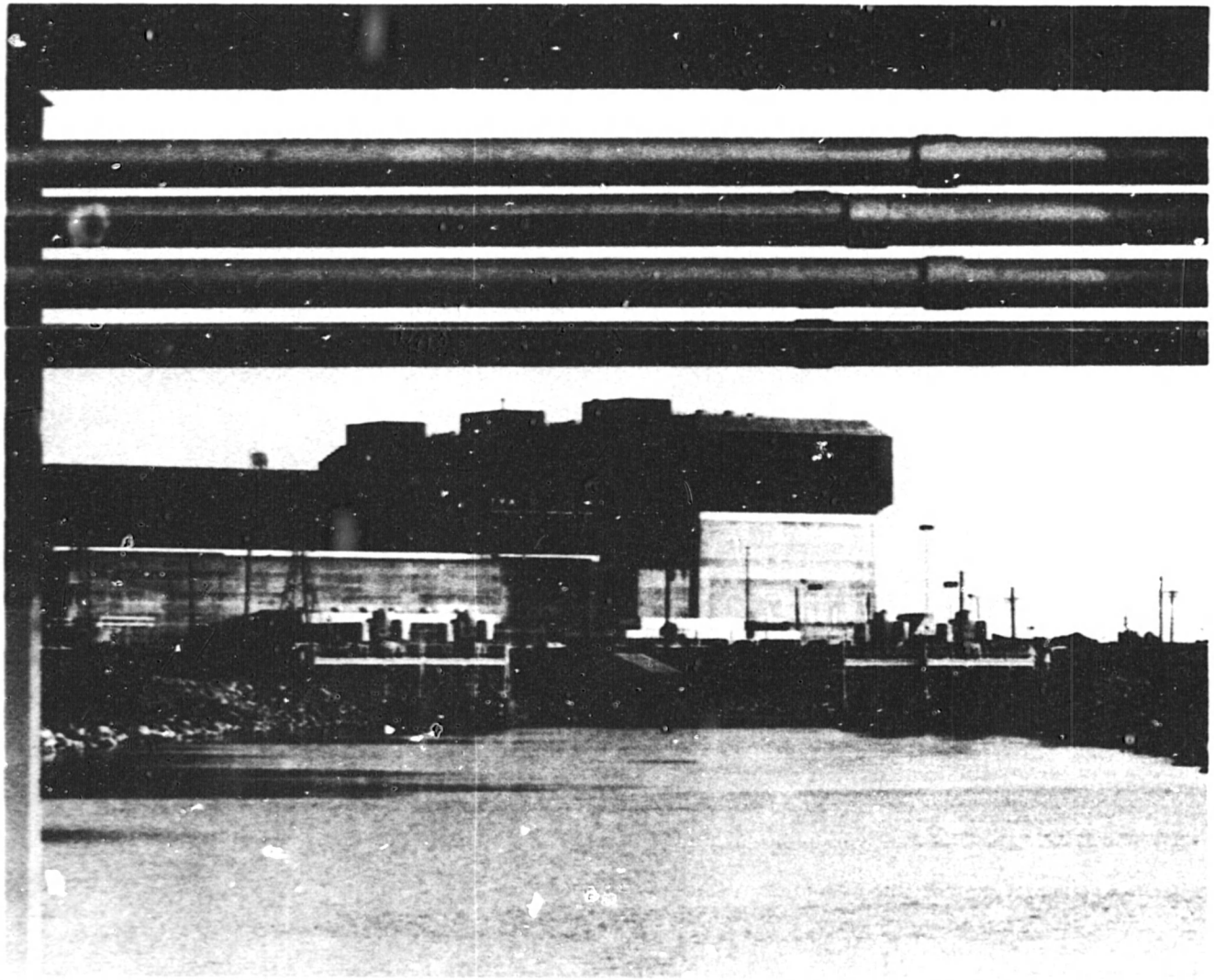
Total power sales for fiscal year 1982 dropped to 108.5 billion kilowatthours from 114.8 billion kilowatthours in fiscal year 1981 for the lowest sales in seven years. Production cutbacks by large industrial users were primarily responsible for this drop in power sales.

The 6.3 billion kilowatthour reduction is the biggest drop in absolute numbers from one year to the next in TVA history. And at 5.5 percent, it is the largest annual percentage decrease in electricity sales since World War II.

Sales to the local electric distribution systems were down one billion kilowatthours from 1981 to 75.7 billion kilowatthours. The distributors' residential sales were down 2.4 percent to 34.7 billion kilowatthours, even though the total number of ultimate residential customers increased slightly. The average annual residential consumption declined from 14,250 kilowatthours to 13,760, due to TVA and distributor conservation programs, rising electricity prices, and mild summer temperatures which greatly reduced expected air-conditioning loads.

Commercial and industrial sales on the local power distributors' systems declined only slightly. However, for TVA direct-served customers, the largest industries, sales were at their lowest level in 18 years at 15.5 billion kilowatthours, down 6.7 billion from 1981. Hardest hit were aluminum plants which reduced energy use by 49 percent in 1982 from 1981 levels.

Sales to Federal agencies were up 1.7 billion kilowatthours to 17.0 billion. The slight increase was due partially to the fact that the Department of Energy seasonal power reduction option ended in late 1981 and in part to the fact that another power supplier dropped a portion of their Department of Energy load, which TVA picked up.

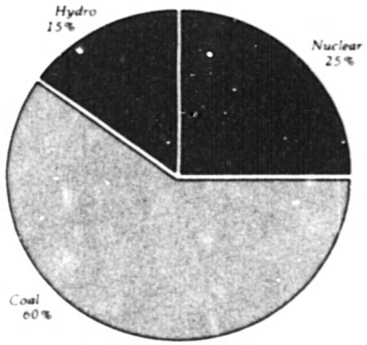


Nuclear power production was up from 21.5 billion kilowatthours in 1981 to 28.0 billion in 1982. Excellent operations at Browns Ferry Nuclear Plant provided about 18 billion kilowatthours of the nuclear generation.

Revenues and Expenses

While sales were down, operating expenses were down as well. Overall system fuel expense declined from $1.45 billion in 1981 to $1.32 billion in 1982. Lower power demands allowed TVA to use much less coal and to back

TVA Power Supply



off much of the higher cost generation during the year. TVA burned just 28.8 million tons of coal during the year, compared to 35.6 million tons in 1981. Coal-fired generation at 68.1 billion kilowatthours in 1982 was at a 15-year low. Many of the higher cost coal-fired units were on standby for extensive periods, and staffs at two coal-fired plants were cut back by 40 percent when the units were placed on standby status. The high-cost combustion turbine units, which provide a standby peaking power source for the system, were fired only briefly in January for peaking purposes and totaled only 32 million kilowatthours for 1982 compared with 131 million kilowatthours for 1981.

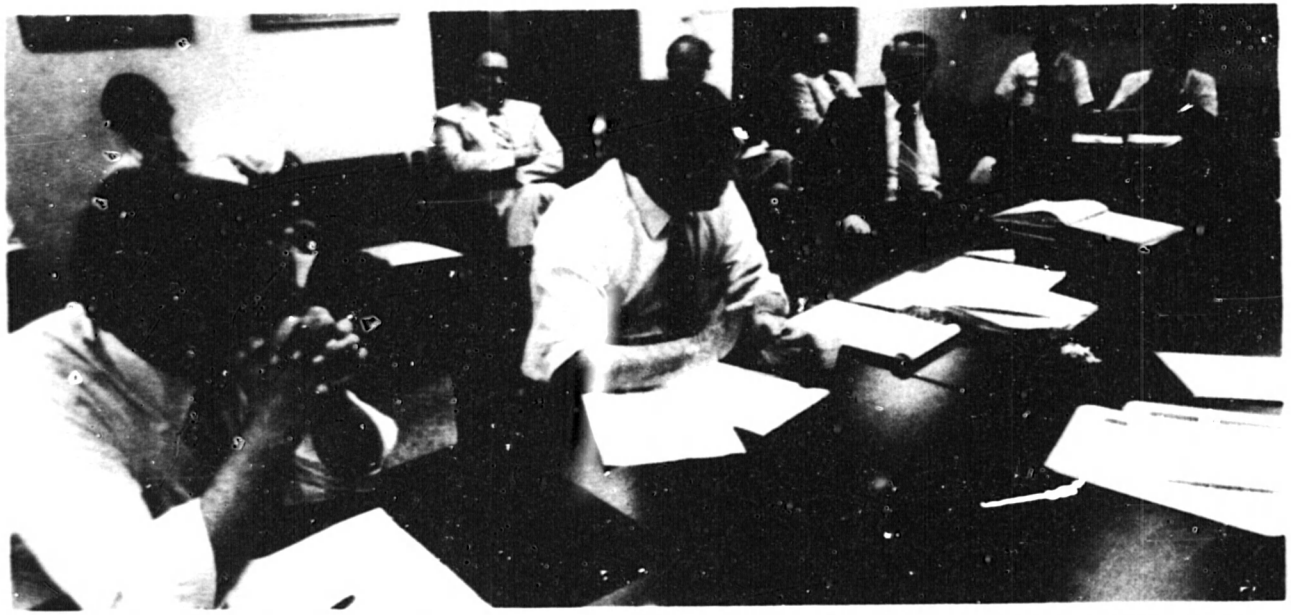
In addition to using less high-cost generation, TVA had more generation available from lower cost sources. Nuclear power production was up from 21.5 billion kilowatthours in 1981 to 28.0 billion in 1982. Sequoyah Unit 2 began commercial generation in June, and the two units at Sequoyah produced nearly 10 billion kilowatthours of power during the year. At the same time, the hydro system climbed back from the dry year of 1981 to more normal generation with 17.8 billion kilowatthours of low-cost power.

Overall system fuel expense was down to 13.81 mills per kilowatthour generated from 14.02 mills per kilowatthour in 1981.

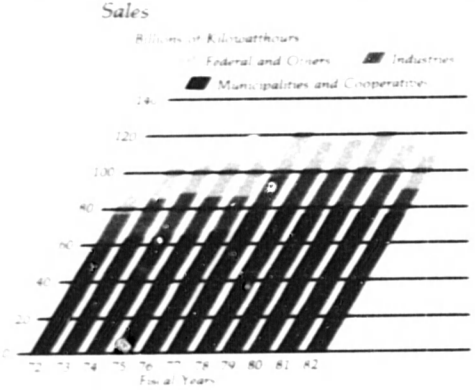
The resulting low overall generating cost proved highly competitive on the interchange power market with our neighboring utilities. In 1982 TVA was a net exporter of power by 623 million kilowatthours.

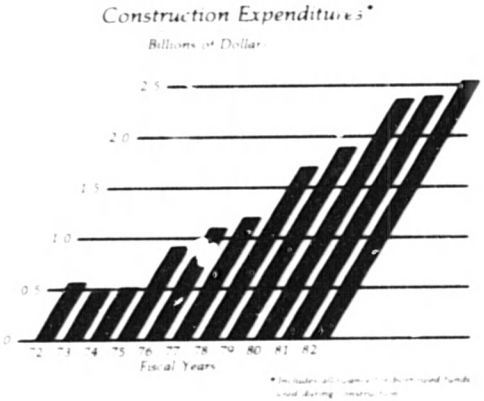
Also in 1982 TVA paid $163 million to States and counties in lieu of tax payments. The amount is 5 percent of revenues from sales of electric energy for the previous year, excluding Federal agencies. Payments in taxes and tax equivalents by the municipal and cooperative distributors of TVA power during their fiscal year (which ended June 30, 1982) totaled $58 million. This made an overall total of $222 million in payments to State and local governments from TVA and distributors, or about $77 per electric customer in the TVA region.

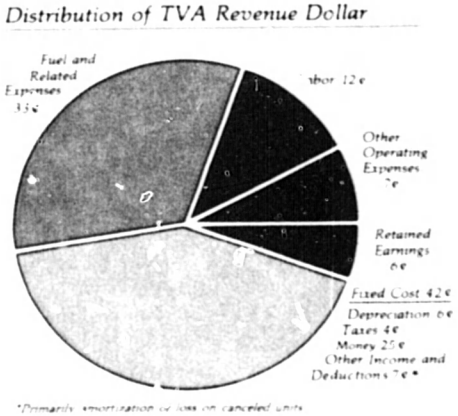
TVA is required to pay a return to the U.S. Treasury on the outstanding appropriation investment in the power system as well as to make an annual repayment on this investment. For 1982 the return on the investment was $109 million, and the repayment amount was



Power people at all levels have been involved in the effort to hold the line on costs. In monthly top management meetings, Power managers focused on financial and budgetary concerns.







$20 million, for a total of $129 million.

Interest payments on TVA power bonds and notes were $1.38 billion.

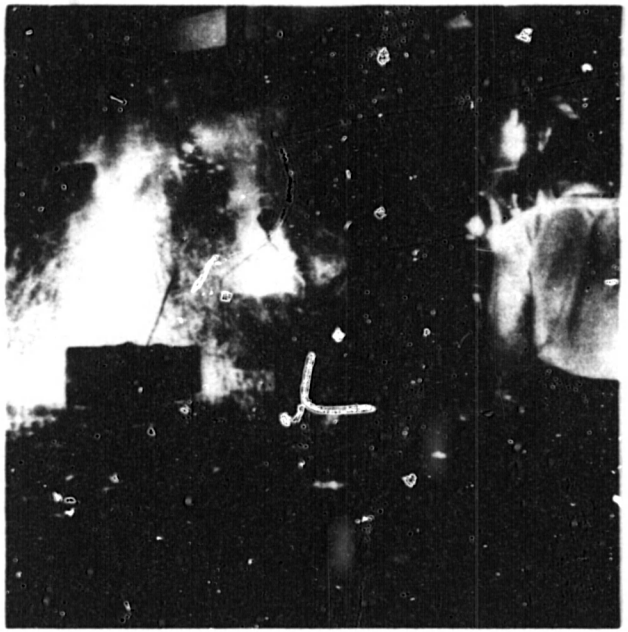
System operating expenses for the year were $2.461 billion, a decrease of $129 million from the previous year. Other income and deductions included a $257 million amortization of loss on the cancelled nuclear generating units.

TVA reported a net income of $390 million for fiscal year 1982. Operating income was 1.10 percent of current year interest charges. A revenue credit of $184 million was declared, of which $140 million was applied initially in fiscal year 1983 and $44 million retained for future application.

Financing

Net borrowings to finance new power plants and other assets were $1.375 billion during the year, bringing the total to $14.160 billion outstanding. Five 30-year term bond issues were sold to the Federal Financing Bank. The first was for $650 million at 13.035 percent, the second for $700 million at 13.565 percent, the third for $300 million at 13.575 percent, the fourth for $350 million at 14.125 percent, and the fifth for $100 million at 11.945 percent. Short-term debt was reduced by $725 million during the year.

TVA entered into a nuclear fuel sale-leaseback arrangement with the Seven States Energy Corporation in fiscal year 1979. The arrangement is designed to benefit present ratepayers by delaying the recovery of interest payments on nuclear fuel until the fuel is burned. The corporation financed its purchases of nuclear fuel from TVA with borrowings from the Federal Financing Bank. On September 30, 1982, those borrowings totaled $1.258 billion, an increase of $366 million during the fiscal year.



Total power sales for fiscal year 1982 dropped to 108.5 billion kilowatthours for the lowest sales in seven years. Production cutbacks by large industrial users were primarily responsible for the drop.

Rates

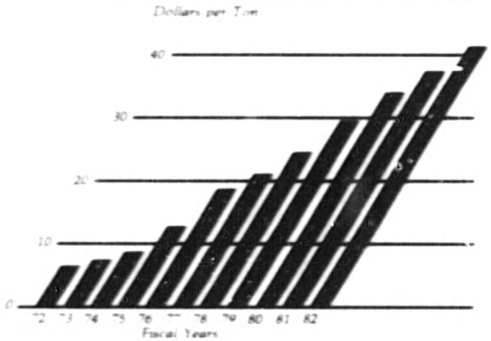
Based on revenue and expense estimates going into 1982, a 9.6-percent electric rate increase for fiscal year 1982 was approved in wholesale rates. And TVA was able to confine its rate actions to that single rate increase for the year. Even though sales and revenues were under the original predictions, good operations and stringent cost control held operating expenses below the original estimates as well.

Local power distributors' residential customers received an average 8.6 percent increase on their average monthly rate. For 1,000 kilowatthours, the monthly cost under the most widely used rate went from $42.05 to $45.67. At the 4,000-kilowatthour level—typical usage for an electrically heated home during the coldest month of winter—the electric bill under this most widely used rate level in the Valley went up from $167.96 in 1981 to $182.44 in 1982.

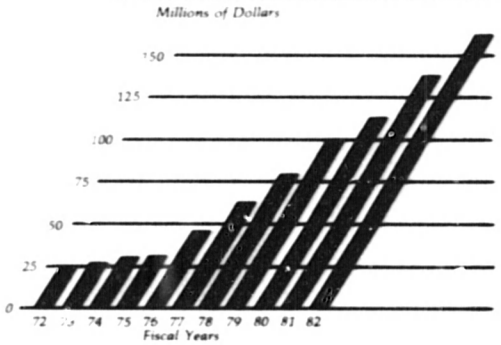
For small commercial users such as barber shops, convenience stores, and service stations, the average cost rose from about 4.9 cents per kilowatthour to 5.6 cents. The medium-use commercial customers (large banks, commercial office buildings, and some light industrial companies) paid an average of 4.7 cents per kilowatthour in 1982 compared with 4.2 cents in 1981. The larger use customers of distributors (large universities and foundries) paid an average of 4.3 cents per kilowatthour in 1982 compared with 3.6 cents in 1981.

Large industries and Federal agencies served directly by TVA paid an average of 4.03 cents per kilowatthour in 1982.

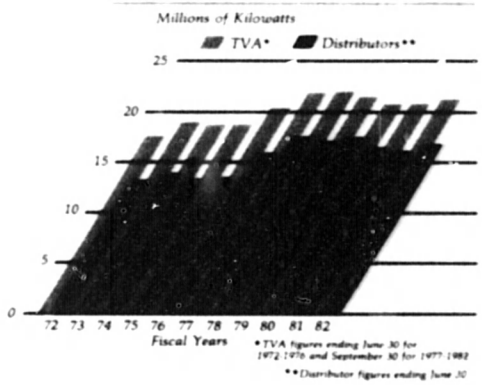
Average Cost of Coal Burned



TVA Payment in Lieu of Taxes



Peak Load



Load Forecasting and Future Power Supply

During fiscal year 1982, we confirmed that the outlook for electricity sales is for very low growth rates compared with historical trends and that the Power program had overcommitted to new capacity. The expenditures required to finance the nuclear construction program were now driving TVA power rates along with fuel costs and at a time when the demand for electricity was falling.

The major factors in determining load growth—economic activity, price and availability of substitute fuels, price of electricity, impacts of conservation programs, and the Department of Energy uranium enrichment program—were examined at various levels of projected growth. Because of considerable uncertainty in predicting each factor and because each can have major impacts on load growth, TVA produced a range of load forecasts designed to reasonably bound the parameters of future possible growth in electricity requirements.

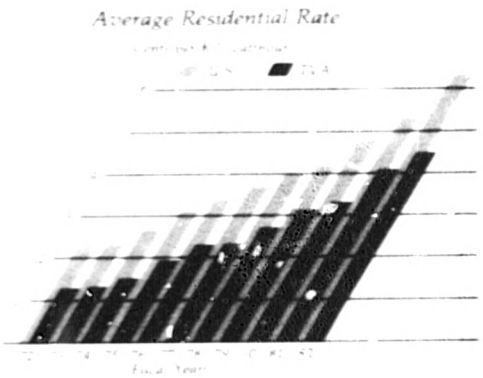
Ultimately, TVA settled on high, medium, and low forecasts for the 1982-2000 period. But decisions regarding capacity expansion were primarily based on the high range of forecasts in order to ensure the capability of meeting regional power requirements if economic growth does follow the high-side estimate. That is our first responsibility as a public utility.

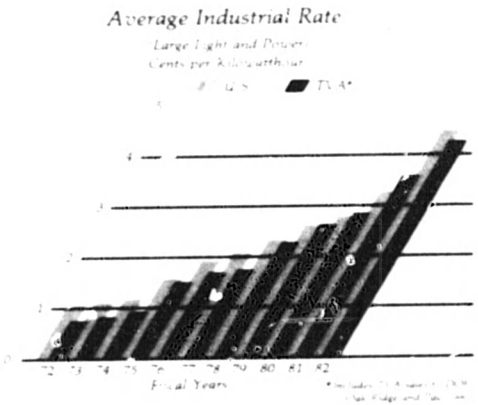
Even under this high-growth forecast, which had only a 10-percent probability of being reached, TVA would not need all of the planned capacity expansion under the existing construction program.

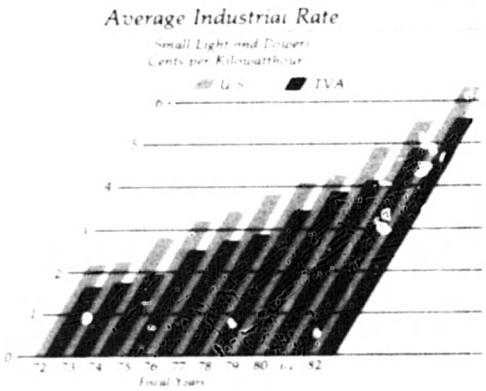
This major policy issue was decided amid the most intensive effort in TVA history to involve the public in planning for the Power program.

The cancellation of four nuclear units will save consumers $546 million over the next 20 years by avoiding expenditures not necessary to provide an ample power supply.

In January 1982, the specific study entitled "Review of the TVA Load Growth/Plant Construction Situation" was given wide public distribution throughout the TVA region. The published analysis explained the load growth outlook and demonstrated that the current construction program was resulting in expenditures much greater than required to meet projected future power demand. It examined the effects of several options available to TVA. Comments were publicly solicited and received from many individual citizens, business groups, political figures, and citizen groups through public meetings, calls to the Citizen Action Office, and through the mail.







The Power work force was cut by 2,000 employees as TVA moved to match Power activities to the market.

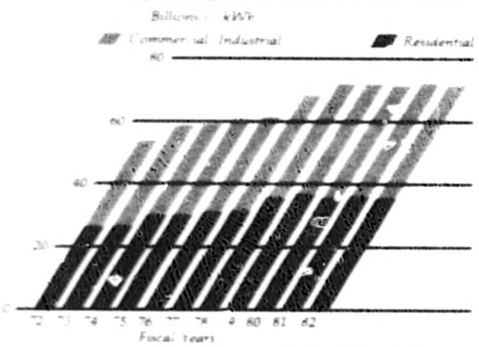
TVA 1982 Nuclear Construction Schedule

		Capacity kW	Percent Complete	Estimated Commercial Operation*
Watts Bar Nuclear Plant	Unit 1	1,270,000	87	2/84 - 11/84
	Unit 2	1,270,000	54	6/85 - 12/85
Bellefonte Nuclear Plant	Unit 1	1,332,000	81	11/85 - 11/86
	Unit 2	1,332,000	60	11/86 - 11/87
Total additional capacity by 1990		6,445,000		
		Indefinitely Deferred Units		
Hartsville Nuclear Plant	A-1	1,287,000		
	A-2	1,287,000		
Yellow Creek Nuclear Plant	Unit 1	1,375,000		
	Unit 2	1,375,000		
		Cancelled Units		
Hartsville Nuclear Plant	B-1	1,287,000		
	B-2	1,287,000		
Phipps Bend Nuclear Plant	Unit 1	1,287,000		
	Unit 2	1,287,000		

*September 1982

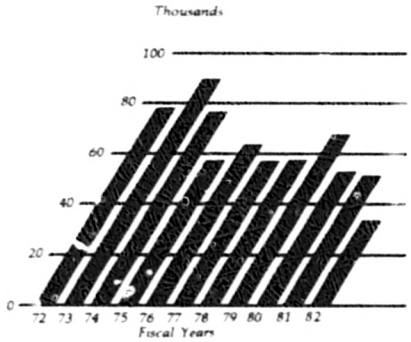
In March 1982, after consideration of all public input, the TVA Board decided to defer construction of the Hartsville A (two units) and Yellow Creek (two units) Nuclear Plants. About five months later in August 1982, the Board also cancelled the Phipps Bend (two units) and Hartsville B (two units) nuclear projects which had been deferred earlier. These actions combined are expected to save consumers $546 million over the next 20 years by avoiding expenditures not necessary to provide an ample power supply.

*Distributor Sales**



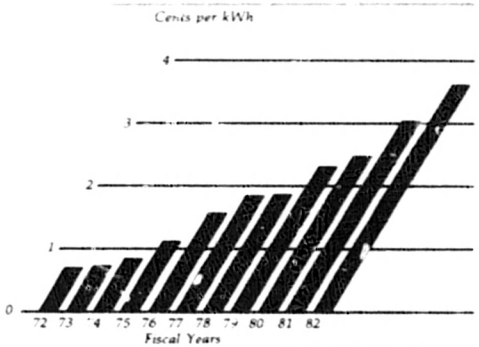
*Based on distributor fiscal year ending June 30 for each year noted.

*Customers Added by Distributors**



*Based on distributor fiscal year ending June 30 for each year noted.

*Wholesale Power Costs**



*Based on distributor fiscal year ending June 30 for each year noted.

Rates

Retrospective

The bottom line for the viability of the TVA Power program is competitive rates. And for much of the 49-year history of the agency, TVA rates have been well below the U.S. national average.

When TVA was established in 1933, the typical residential cost of power nationally was about 5.5 cents per kilowatthour, where power was available. TVA leadership reviewed the potential use of electricity in the Valley and set retail rates at about half the typical rates in order to promote the widest possible use of power.

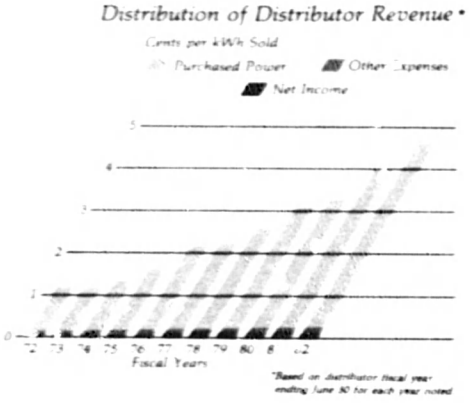
In 1937 residential rates for TVA power averaged 1.85 cents per kilowatthour, and the national average cost was 4.30 cents. From 1940 through the 1960s, both TVA and national residential rates declined, with TVA remaining at about one-half the national average. During the 1960s, TVA residential costs were less than one cent per kilowatthour.

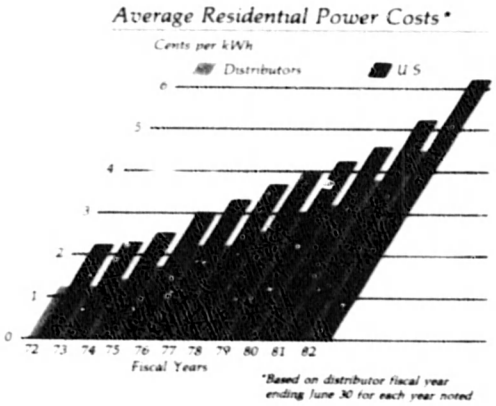
As might be expected, average annual residential usage in the Valley soared from 1,379 kilowatthours in 1937 to 8,806 in 1960 to 14,560 in 1970, peaking at 16,400 in 1977. Valley residents were using more and more electrical energy and using it for basic functions such as home heating.

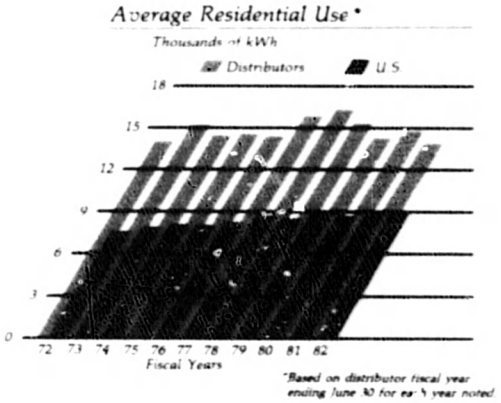
Usage nationally tracked the TVA pattern, but at much lower levels. National average annual residential use was 805 kilowatthours in 1937—3,707 in 1960, and 6,810 in 1970.

Beginning in 1970, inflation and the oil embargo, high interest rates, increasing construction, labor, materials, and fuel costs began to pull costs up overall.

Average annual residential use in the Valley soared from 1,379 kilowatthours in 1937 to 8,806 in 1960 to 14,560 in 1970, peaking at 16,400 in 1977. Responding to rising prices and conservation programs, residential consumers began to moderate usage in the late 1970s. Average annual use in 1982 was 13,760.







National average residential rates rose from 2.09 cents per kilowatthour in 1970 to 6.34 in 1982. The TVA area average was 1.03 cents per kilowatthour in 1970 and 4.62 in 1982. Residential usage in the Valley flattened, while average national residential use continued to climb, but slowly, reaching 8,903 kilowatthours in 1982.

TVA's competitive edge at the commercial and industrial levels, traditionally sharp, has been reduced by the effects of escalating costs. In 1972, the average commercial and industrial rate for the Nation was 1.47 cents per kilowatthour. For TVA, it was 0.83 cents, 44 percent below the national average. By 1981 the national rate was 4.48 cents per kilowatthour, and TVA was, at 3.52 cents, about 21 percent below the national average.

Recognition of the situation and decisive action in holding the line on costs during the year enabled TVA to move through 1982 with a single rate increase of less than 10 percent and end the year with an outlook for much more stable rates in the future.

Rate Design

As TVA has worked to bring rate increases under control, we have also been reviewing better ways to price power to consumers. The goal is to assure that rates encourage wise use of a valuable resource and allocate energy costs fairly. One proposed change in billing procedures would offer time-of-day (T-O-D) rates or billing the consumer according to the cost of producing power at the time it is used.

In accordance with the provisions of TVA's power contracts, TVA and the local distributors of TVA power continued consideration of this and other proposed changes of the agency's schedule of rates and charges during fiscal year 1982. Also considered was the method of allocating the benefits of low-cost hydro power to residential consumers.

The discussions revealed that considerable confusion existed as to how some portions of the proposed changes would affect individual consumers. Therefore, TVA again invited public comment concerning both T-O-D rates for consumers with loads greater than 5,000 kilowatts and the distribution of benefits of low-cost power sources to residential consumers under the TVA Act.

Following the public session chaired by the TVA Board in May 1982 and after considerable written comment, TVA decided to provide T-O-D rates on a voluntary basis. TVA determined that, based on balancing the need for continued economic growth with the potential hardships that rate increases pose for the residential consumers, the practice of allocating benefits of low-cost hydro power to the residential consumers should be maintained. As a result of TVA's decision, the hydro power allocation will apply, when implemented, over the first 2000 kilowatthours per month of residential use, increasing from 500 kilowatthours now. T-O-D rates will be voluntary for users with demands greater than 5,000 kilowatts at this time and available on a voluntary basis to other general power consumers and to residential consumers at each distributor's option.

These decisions were incorporated into the proposed rate changes which were under discussion with the distributors of TVA power in the latter part of 1982. It was anticipated that some of these changes will be implemented during fiscal 1983.

A low overall generating cost proved highly competitive on the interchange power market with our neighboring utilities. In 1982 TVA was a net exporter of power by 623 million kilowatthours.

Retrospective

From the beginning, TVA's mandate was broad—to tame and make productive a river system through the development of its natural and economic resources. Power production was a means to generate new and better ways of living for the people of the Valley. The public story, the new hope and new life provided by abundant, economically priced electric energy, has been well documented. But the behind-the-scenes story of TVA men and women pushing out the technology of electric power to support that new hope is equally dramatic.

As individual TVA dams were finished in the 1940s, hydro power, at first virtually the sole source of generation, supported rapid growth and carried TVA consumers even through the urgent demands of World War II. By the late 1940s, the energy potential of the river was thoroughly tapped, and the need for power continued to climb. TVA moved forward into the coal era. In the 1950s and 1960s, the agency pioneered the large central generating unit technology which, through the economies of scale and higher operating temperatures and pressures, offered greater operating efficiencies. This meant larger amounts of power could be produced while holding unit costs stable. Meanwhile, local power distributors were reducing the unit cost of delivering power to their customers through higher and higher volume sales.

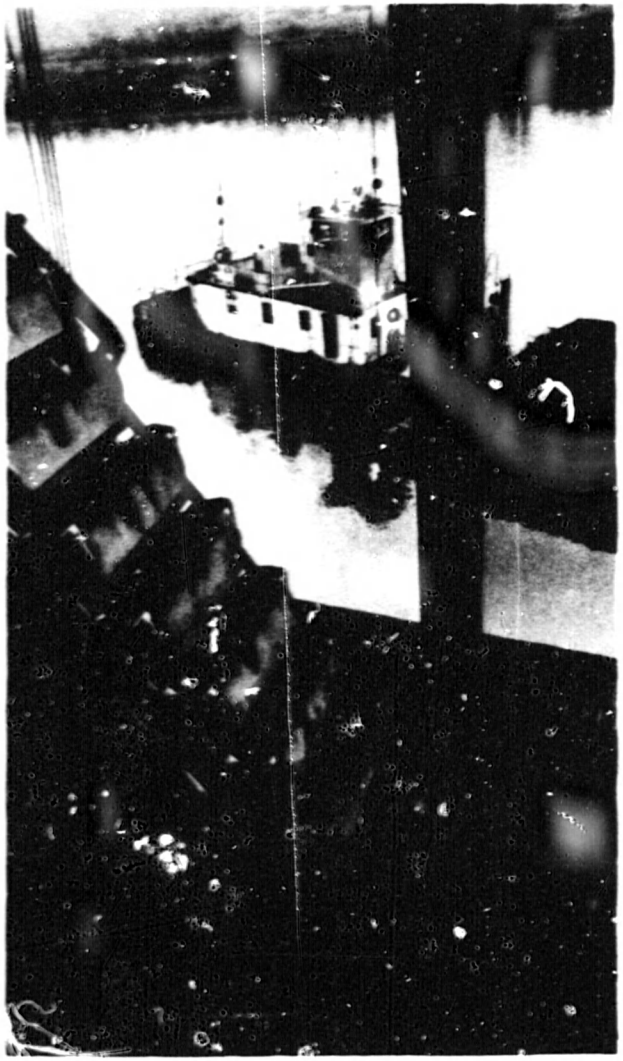
In the 1960s the agency entered the next major era in generation—nuclear power plants. By the mid-1970s, TVA had committed to build 17 nuclear units at seven nuclear power plant sites.

As the production technology advanced, so did the systems by which power could be managed and transmitted. Because of TVA's initiative and leadership in the development of the 500-kV transmission system, today's system has the ability to transfer large blocks of generation from one area of the system to another. This capability enables the scheduling of generation to allow the operation of the most efficient units to meet power needs anywhere in the region.

The evolution of the load control system has been equally dramatic and valuable. From the first dispatch and control center in the control room at Wilson Dam to the establishment of the specially constructed Power System Control Center, TVA has been a pacesetter.

Recent gains have returned TVA to the top ranks of the U.S. electric utilities in the area of heat rate. In 1982 alone the effort saved TVA consumers about $12 million in fuel costs.

Working on the leading edge of technology, TVA moved the load dispatching function from the days of manual generation change, based on telephoned instruction from the dispatcher, to advanced telemetering and automatic generation control. Today TVA power plants, 229 generating units in all, are controlled from the Power System Control Center in Chattanooga. Technology permits TVA to generate from the cheapest to operate plants available at any given time.



Coal remains the backbone of power supply for TVA, supplying 60.2 percent of total generation in 1982.

Operations

Operation of the power system in 1982 exemplified the use of the lowest cost resources to meet a changing load and power supply situation.

The net system load was down 6.7 billion kilowatthours from 1981, while low-cost hydro generation was up dramatically, coming out of the severe drought in 1981 with a 6.1 billion kilowatthour improvement in 1982. Low cost nuclear generation was up by the largest amount since 1975, an improvement of 6.1 billion kilowatthours over 1981.

As a result of the availability of low-cost power TVA was a net exporter of power in 1982 with a difference of 5.2 billion kilowatthours from 1981 when the agency had been a net importer of power.

Responding to those changes, the system coal-fired generation was reduced by 14.1 billion kilowatthours.

The situation was basically this: 1982 generation costs were hydro, 0.19 cents per kilowatthours, nuclear 1.19, and coal-fired 2.27. TVA meets load with the lowest cost generation mix. With load down, and the availability of low-cost generation up, the more expensive generation was dropped out first. In terms of base load power that meant the coal-fired units with the highest production costs.

Coal-fired generation dropped from 82.3 billion kilowatthours in 1981 to 68.1 in 1982, while nuclear power provided 28.0 billion kilowatthours, about 25 percent of the total, up from 21.5 billion in 1981. Excellent operation at Browns Ferry Nuclear Plant, even with considerable downtime necessary for safety modifications there, provided about 18 billion kilowatthours, and Sequoyah unit 2 came online during the year to join unit 1 in producing nearly 10 billion kilowatthours of power.

Hydro power was just above normal generation at 17.8 billion kilowatthours in 1982 after dipping to well below the normal generation in 1981 at 11.6 billion kilowatthours.

With demand down and plenty of low-cost generation available, coal-fired generation dropped to its lowest level since 1967, a time when total system generation for TVA was only 85.9 billion kilowatthours.

Another phenomenon of this new energy era appears to be greater swings in energy use, requiring the power system to have considerable capacity available with lower average use. During 1982 an alltime net system peak was set on January 11 when requirements from all TVA consumers reached 22,500 megawatts. But in the same year on June 6, the net system load dropped below 8,400 megawatts, only 28 percent of current capacity and the lowest June level in 10 years. During the peak, Raccoon Mountain, TVA's pumped-storage facility, operated at 100-percent capacity for the first time. It provided a saving of $3.2 million in replacement power costs during the month of January.

Overall in 1982, amidst low demand and a slow economy, the agency demonstrated its continued determination to cut operating costs and maintain the flexibility and reliability of the power system.

Even with the reductions, coal remains the backbone of power supply for TVA, supplying 60.2 percent of total generation in 1982 compared with 68.6 percent in 1981. And any action which affects operations at coal-fired plants can have significant effects on TVA costs. TVA has had major efforts underway since the 1970s to improve the operations of its coal-fired units.

Heat rate is a principal measure of efficiency, and in 1982 heat rate at TVA's coal-fired plants was a continuing success story. Heat rate is the measure of how many Btu's of coal are required to produce a kilowatthour of electrical energy . A lower heat rate means less coal is burned per kilowatthour of output. In 1982 heat rate was down to 9,910 Btu per kilowatthour of generation—280 below the peak of 10,190 for the 12-month period ending the second quarter of fiscal year 1978 and 100 below the 1981 level of 10,010. That drop saved $12 million in fuel costs between 1981 and 1982. During the 1970s when load continued to grow and nuclear plants were delayed in coming online, the coal-fired plants were run almost continuously with a minimum of time out for maintenance and improvements.

If TVA had been included in the national ranking of publicly owned utilities, TVA coal-fired plants would have ranked number three in heat rate for 1982 nationally.

Other coal-related statistics have improved as well. The forced outage rate was improved from 10.48 percent in 1981 to 7.23 percent in 1982, the lowest level since 1973. That meant plants were more available when needed in 1982.

Efficient operations in 1982 were not limited to the coal-fired plants. The two nuclear plants rank above the national average for all nuclear plants in two key measurements of efficiency—availability and capacity factors. Availability is the percentage of time a unit is available for service. Capacity factor is the percentage of power

a unit actually produced compared with the amount it could have produced operating continuously in a period of time.

In 1982 TVA moved near the completion of a program to minimize emissions from its coal-fired plants. Matching systems to individual plant conditions, the agency is using low-sulfur coal, baghouses, limestone scrubbers, coal-washing facilities, and fly ash precipitators. All 63 coal-fired units were in compliance with the Clean Air Act requiring emissions to meet primary, (health related) ambient air quality standards as of December 1982. Additionally, when the scrubbers on Paradise units 1 and 2 are completed in December 1983, all of our units also will meet secondary, ambient air quality standards. When all installations are complete in 1983, total emissions of particulates from coal-fired plants will have been reduced by over 90 percent, and emissions of sulfur dioxide will have been reduced by one-half.

The capital cost of the air quality program is $1.082 billion. The total annual operating expenses including amortization, purchase of low-sulfur coal, coal washing at Paradise and Cumberland, operating and maintenance costs including efficiency losses are expected to be about $376 million (1982 dollars). Together, they have raised the cost of electricity to consumers by about 5 to 8 percent.

Fuels

Increasing efficiency and economy were achieved in many other areas of operations. In the Nuclear Fuels Branch of the Division of Fuels, a Reload Core Design and Analysis Program was introduced to provide a significant saving. TVA is designing the arrangement of fuel bundles within the core instead of paying a vendor for that service. Working in-house will shorten planning time required for the fuel core design and provide a design tailored to TVA's unique needs. Cost reduction is a major benefit, but TVA will also enjoy increased flexibility and the enhanced competition for fuel supply.

During fiscal year 1982, approximately 4.6 million pounds of U-308 was supplied to TVA through procurements from nuclear fuel suppliers and production from uranium mineral rights properties. Since the early 1970s, a total of approximately 15 million pounds of U-308 has been delivered to TVA from uranium suppliers, and approximately 1.5 million pounds has been produced from mineral rights properties. These activities are being adjusted to meet declining uranium market prices, slippages in nuclear plant construction schedules, and TVA's current uranium inventories.

A Reload Core Design Program allows TVA to design the arrangement of fuel bundles within the nuclear unit core. The program pays off in terms of cost reduction and increased flexibility.

TVA made its first uranium loan in 1982, lending surplus uranium valued at $5 million to a German utility and thereby eliminating some holding costs.

A saving was noted in coal procurement as well. TVA acquired Peabody Coal Company's assets of mine slopes, shafts, mining equipment, and surface facilities at the Camp Breckenridge, Kentucky, complex. TVA has long owned the coal and contracted with Peabody to supply coal from it. TVA now pays the cost of coal production and pays a management fee to Peabody. The saving to date from the difference in the cost-of-production versus the contract-price basis is approximately $10 million more than the acquisition cost of the assets.

Energy Initiatives

Conservation

TVA has established that energy conservation is a viable, economical alternative to increasing future power plant expansion.

TVA energy conservation programs are providing immediate benefits to our consumers, saving the cost of 1.4 billion kilowatthours annually in fiscal year 1982 for more than 330,000 residential, commercial, and industrial consumers.

In terms of conservation, two significant milestones were reached in 1982—the completion of the 500,000th residential home energy survey under TVA's Home Insulation Program and a move to consolidate the residential conservation programs into a single, unified, cost-effective approach known as The Energy Package™.

Reaching the one-half-million point in residential energy surveys marked the highest audit penetration rate in the country among larger utilities.

Residential Conservation

Home weatherization is especially beneficial in the Tennessee Valley where more than 90 percent of the residents use electric heat, and the overall consumption of electricity is about one and one-half times the national average. TVA's Home Insulation Program, established in 1977, provides free home energy surveys, long-term, low-interest or no-interest loans for insulation and other weatherization measures to help consumers reduce their use of electricity, and inspections of the finished work.

Conservation methods installed under the program are now saving more than one billion kilowatthours annually. During fiscal year 1982, 129,625 surveys were conducted in 173,541 living units, and the total number of dwellings weatherized under this program increased to 324,541.

TVA also offers—through 127 participating distributors—a heat pump service whereby consumers may receive a heat pump survey and qualify for financing of the installation of a heat pump and a post-installation inspection—if their dwellings are weatherized to TVA standards.

By the end of 1982, more than 36,000 consumers had requested heat pump surveys. More than 19,000 units had actually been installed, and the annual saving to the power system totalled 70 million kilowatthours.

In late 1982 a similar service for heat pump water heaters was offered to distributors.

Solar water heaters, another way to switch to renewable energy, were offered in 1982 in Memphis, Nashville, and rural middle Tennessee areas. The solar heaters can save as much as 80 percent of the electricity used by conventional electric water heaters. Approximately 3,000 consumers were participating in TVA's solar water heater financing and inspection plan by the close of the fiscal year.

Under TVA's Wood Heater Program, participating distributors in environmentally acceptable areas offer consumers surveys and financing for wood heating systems. During fiscal year 1982, 1,343 consumers installed wood heaters, bringing the total to 4,505 installed under the program.

Residential Load Management

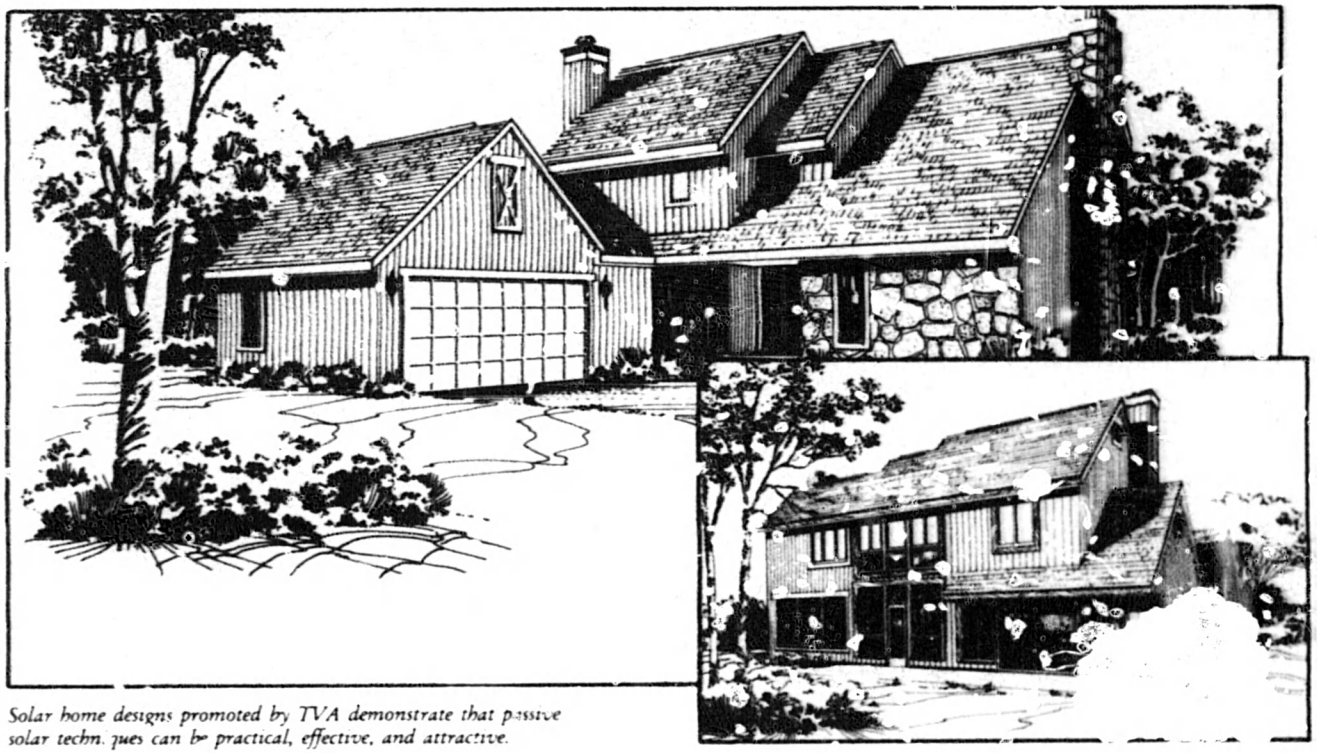
TVA is working to reduce electricity usage during peak hours when generation is most expensive.

To involve consumers in this load management effort, TVA is offering participants credits on their electric bills for joining the Cycle & Save Program. The incentives are provided for air-conditioning cycling and for water heater cycling. Remote controlled radio receivers are used to briefly cycle, or interrupt, the flow of electricity to the appliances when needed to reduce peak demand.

Potential savings to the power system from cycling installations equal 17.8 megawatts in the winter and 32.1 megawatts in the summer. Cycle & Save participation was expanded to a total of 30 distributors in fiscal year 1982.

Solar Homes

In order to demonstrate that passive solar designs can be practical and effective, TVA initiated in 1979 a Solar Homes for the Valley project. The program encourages the use of passive or nonmechanical solar features in conventionally built new homes. By 1982, 35 homes had been designed and built to collect and use solar heat.



Solar home designs promoted by TVA demonstrate that passive solar techniques can be practical, effective, and attractive.

To make the economic benefits of passive solar technology even more widely available, TVA initiated a Solar Modular Homes Project. Through the project, technical and financial assistance is being provided to five modular home manufacturers for the design and construction of TVA-approved passive solar homes. Three homes were sited in 1982.

To encourage the construction of energy-efficient homes, the TVA Energy Saver Home Program was initiated in late 1981. Through the program, TVA is assisting Valley home builders in the development of energy efficient building packages that include conservation and solar options.

Public response to the Energy Saver Home Program has been significant, even during the worst slump in housing starts in decades—727 new homes were certified under the program in mid-January to October, and another 1,000 were under construction. Home mortgage bankers and lenders have begun to recognize these design advantages in their credit decisions.

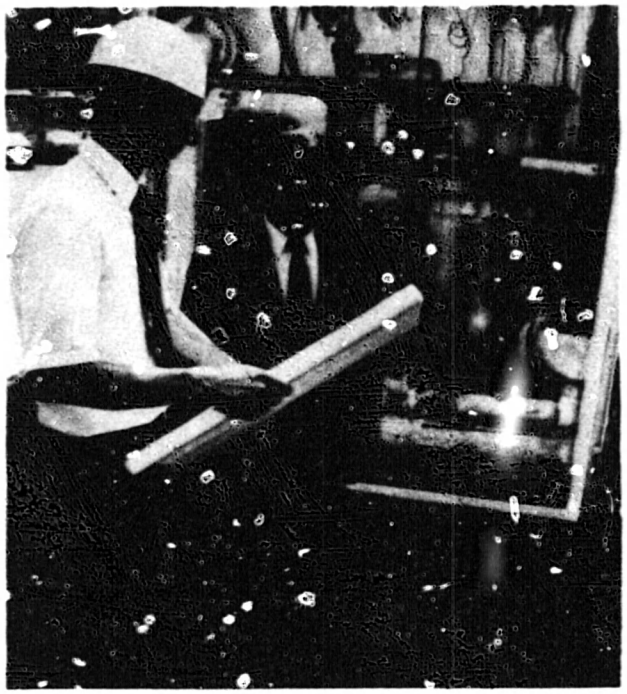
Low-Income Initiatives

Helping the elderly, the poor, and those on fixed incomes find alternatives to offset the increasing cost of electrical service is also a part of TVA's responsibility in the Valley. And the TVA energy conservation programs have provided opportunities for TVA, distributors, and other Federal, State, and local agencies.

Carrying the message to those consumers was given major emphasis in 1982, and low-income participation in TVA's Home Insulation Program increased from 9.4 percent prior to 1980 to 38.7 percent through March of fiscal year 1982.

Conservation for Commerce and Industry

Through the Commercial and Industrial Conservation and Energy Management Program, TVA and its distributors work to help commercial and industrial consumers meet the challenges of the new operating environment. These users request evaluations or surveys from their power distributors or the TVA district offices. A conservation team makes an onsite evaluation of energy use and offers recommendations for improvements. TVA also offers loans of up to $100,000 at low interest cost



The Jackson-Madison County Health Department in Jackson, Tennessee, reduces its demand on the TVA system during peak hours by cooling with ice made in the electrical storage unit during offpeak hours.

to help consumers make changes in physical features or operations that will conserve electrical energy.

A total of 4,850 buildings were surveyed during fiscal year 1982. And more than 14,700 opportunities to increase energy efficiency were identified.

TVA also provided energy conservation analyses for firms which were planning expansion or for new firms locating in the Valley as well as direct technical and design assistance through TVA's Passive Solar Heating and Cooling Program.

To more effectively tap the energy potential of extensive Valley forests, TVA conducts a Biomass Program through which the people who design heating systems and industrial boilers are offered technical assistance in the use of wood.

Passive solar design strategies have been integrated into TVA's own buildings. Other TVA buildings have been retrofitted with active solar systems for space heating and/or water heating. Also, where utility power is not readily available, photovoltaic systems have been installed.

Commercial and Industrial (C&I) Load Management

Like the residential consumers, commercial and industrial consumers are encouraged to shift their use of electricity to offpeak hours whenever possible. Fourteen organizations are participating in commercial and industrial load management demonstrations implemented in conjunction with a T-O-D rate to determine the benefits of reducing energy demands through thermal storage. In the demonstrations, the lower cost energy produced during offpeak periods was stored in heating or cooling devices and released during peak hours.

Industrial Development

During the fiscal year, TVA recorded 372 announcements by industries of plans to build new facilities or expand existing operations in the region. The announcements may represent the addition of an estimated 20,000 new jobs and an investment of an estimated $970 million.

Cogeneration and Dispersed Power

Cogeneration, the production of both electrical energy and process heat energy from the same primary fuel, and dispersed power, electricity produced by small power producers, offer an opportunity for additional, low-cost energy. TVA encourages these energy resources by providing a favorable market for this energy.

Three plants signed cogeneration contracts with TVA in 1982, increasing the contracted amount of cogeneration from 6,625 kilowatts to about 97,475 kilowatts. Unfortunately, national economic conditions have lowered the demand for manufactured products from some of the plants, and the output of some of the cogeneration facilities was reduced in 1982.

One 50-kilowatt wind energy conversion plant was 95-percent complete at Viking Mountain, near Greenville, Tennessee, in fiscal year 1982. And a solar photovoltaic demonstration was conducted at the 1982 World's Fair in Knoxville, Tennessee, the first solar installation to produce electrical energy for a distributor of TVA power.

Research and Development

Atmospheric Fluidized Bed Combustion

"This is a piece of technology that can take all this abundant high-sulfur coal in this part of the world and use it—use it just as cleanly and just as efficiently, just as cost effectively as the low sulfur coal . . . This is a giant step forward in environmental protection as well as energy self-sufficiency. It also demonstrates that the Tennessee Valley Authority is not just another utility . . . This fluidized bed plant shows that TVA is going to lead the way into the future."

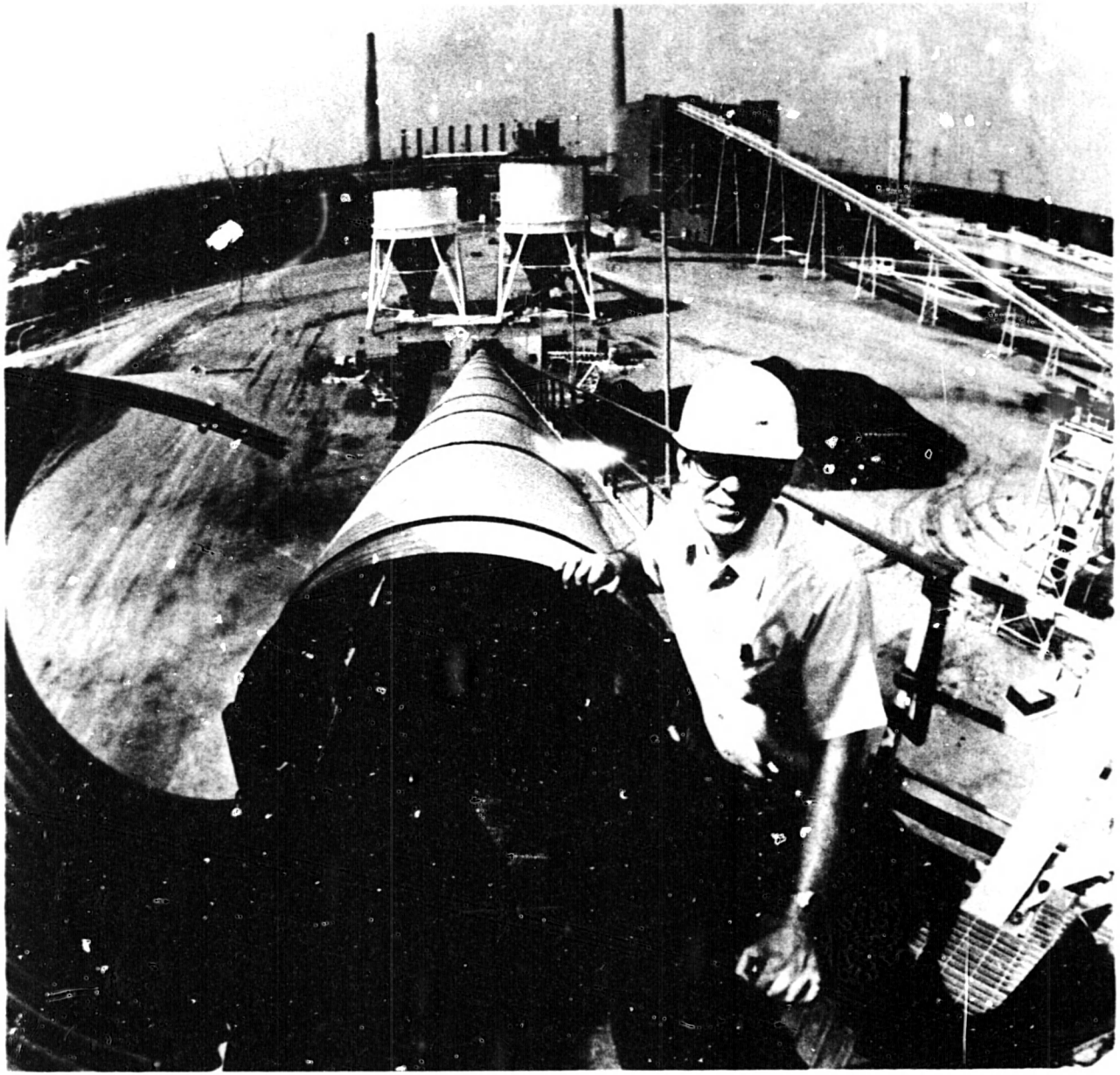
S. David Freeman
Director

With those words TVA dedicated a 20-megawatt AFBC Pilot Plant in August 1982 and summed up its overall commitment to research and development. The AFBC technology offers the utility industry an opportunity to utilize abundant and less costly high-sulfur coals which are not being used in conventional power plants because of air pollution control standards. Because the capture of sulfur is inherent during the AFBC combustion process, the opportunity exists to use these coals fully and to maintain environmental performance. Additionally, due to low combustion temperatures, the production and release of nitrogen oxides are significantly less than conventional coal-fired plants.

The AFBC Pilot Plant began shakedown operations in May 1982, and a 4-year test program was begun. Major test program objectives are to develop economic, technical, and environmental performance data for the technology to be used in the design and construction of the demonstration plant. The unit operated approximately 934 hours and consumed approximately 4,262 tons of coal and 1,540 tons of limestone during this fiscal year.

Based on recent studies, TVA has concluded that the next major step, a utility-scale demonstration facility, can be accomplished by replacing an existing pulverized-coal-fired boiler with an AFBC boiler. TVA believes this approach will accomplish the goals of demonstrating the essential elements of the technology at a significantly lower cost than a new standalone facility.

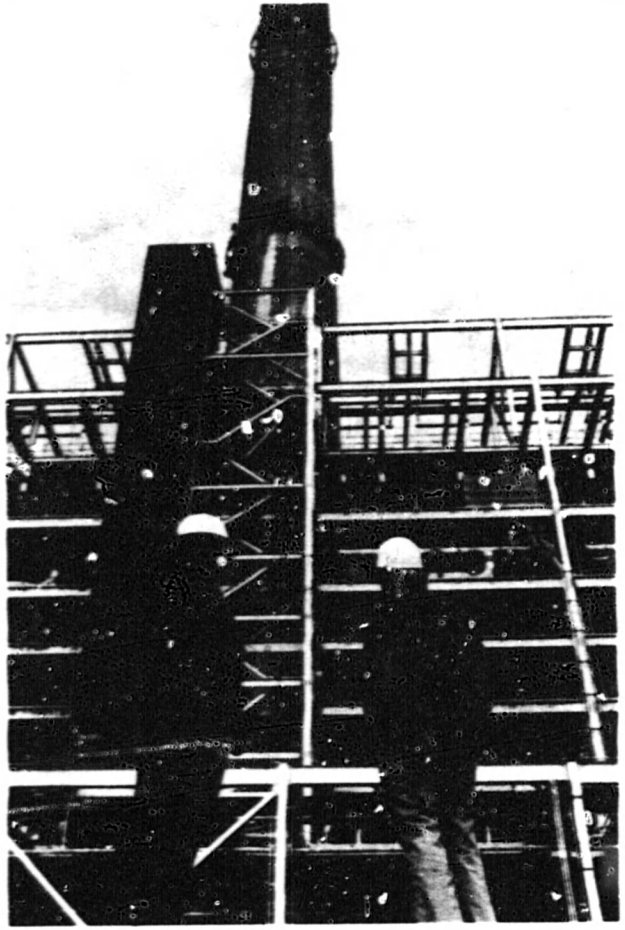
TVA is preparing a response to the Electric Power Research Institute's request for a host site for a 100- to 200-MW demonstration of an AFBC steam generator. A formal proposal will be submitted in the early part of 1983. During the coming years, TVA will be vigorously pursuing commitments and outright funds or in-kind services from EPRI, other utilities, foreign countries, the Federal Government, coal companies, equipment vendors, and others to secure the necessary resources to build the demonstration facility.



The 20-megawatt AFBC Pilot Plant, dedicated during 1982, symbolizes TVA's commitment to research and development.

Fuel Cells

TVA is assisting in research on the fuel cell power plant as a dispersed, modular power generator with multifuel capability. Advantages of the fuel cell option include short construction time, high efficiency that is relatively constant as load varies, minimal environmental impact that allows siting these facilities near centers for power demands, and the potential for cogeneration. Future applications for the fuel cell generator in the TVA power system may include peaking or load-following applications and industrial cogeneration applications. The Division of Energy Demonstrations and Technology staff is cooperating with EPRI, DOE, and other members of the Fuel Cell Users Group to determine the technical and economic feasibility of the fuel cell generator.



TVA's Flue Gas Desulfurization test facility, located at the Shawnee Steam Plant near Paducah, Kentucky, is the center of TVA's research into air pollution control technologies.

The fuel cell program includes an agreement with DOE to provide technical support to the DOE fuel cell program and a cooperative research agreement with EPRI to test TVA's 250-kW phosphoric acid fuel cell stack. TVA's fuel cell projects are designed to determine the application of this technology to a utility power system.

TVA's fuel cell projects are designed to determine the application of this technology to a utility power system.

Flue Gas Desulfurization

TVA's FGD test facility, located at the Shawnee Steam Plant near Paducah, Kentucky, is the center of TVA's research into air pollution control technologies. Since 1971, this facility has tested and demonstrated a variety of FGD technologies. FGD removes harmful sulfur dioxide pollutants by spraying power plant flue gas with a water and lime or limestone mixture. Additionally, advanced FGD technologies that more effectively remove pollutants and create potentially usable by-products are under testing and development at the Shawnee site.

Based on research at Shawnee and other facilities, TVA has built and is operating a full-scale wet limestone FGD system at the Widows Creek Steam Plant near Stevenson, Alabama. The Widows Creek FGD system has fulfilled its function as a full-scale research and development facility and, subsequently, a compliance facility to meet State and Federal emission regulations. Designs of FGD facilities being installed in other TVA plants reflect advancements which have been developed at Shawnee.

FGD systems under research and development at TVA's FGD facility include the DOWA process. The DOWA alkali process has had full-scale commercial application to oil-fired boilers in Japan. Recent tests have evaluated the process on flue gas from high-sulfur coal.

Recently, another series of experimental tests at TVA's FGD test facility showed that certain additives to the FGD process can prevent scale buildup in limestone scrubbers. The results of this potentially important discovery are being evaluated and should be published during 1983.

Solar Pond

To extend the potential for renewable energy resources, TVA is working to determine the technical and economic feasibility of a solar pond for supplying low temperature process heat for light industry and commercial users in the Valley. In 1982 the agency completed construction of a one-acre experimental, nonconvecting salt-gradient solar pond near Chattanooga, Tennessee.

TVA also provided technical and financial assistance to a hospital in Georgia which plans to build an innovative shallow solar pond in 1983. The pond would replace about 8,000 gallons of fuel oil now used each year to heat water for the hospital's laundry, physical therapy, and other applications.

Energy From Municipal Waste

More than 5.8 million tons of solid waste are produced annually in the TVA region. The garbage contains the energy equivalent of nine million barrels of crude oil.

TVA has assisted Sumner County, Tennessee, in the design, construction, and operation of a solid waste cogeneration unit. The plant began operation in January 1982. In the first year of operation, the facility produced 186 million pounds of steam from 35,000 tons of garbage. The combustion system reduces solid waste volume by 90 percent, thereby extending the life of the landfill for this waste tenfold.

In 1982 TVA worked with 12 counties in the region to develop regional waste management plans. Technical assistance was provided to 28 other communities actively developing energy-from-waste plans.

Power Plant Availability and Performance

Among power plant auxiliaries, condensers are the most frequent source of poor unit availability. A recent study revealed that corrosion/erosion and fouling are the major causes of condenser-related generating losses. Cleaning costs and costs of replacement power while cleaning can be significant.

In the past, chemical oxidants, especially chlorine, have proven effective in controlling microfouling in the tubes and were used widely by utilities. Federal regulations have restricted the application of chlorine for biofoul-

ing control to minimize free residual chlorine in cooling water discharges.

TVA initiated a project and completed conceptual design in 1982 for the development of a novel condenser chlorination technique which should provide better condenser performance as a result of better biofouling control and the ability to meet EPA effluent standards without having to resort to costly chemical dechlorination. It also will decrease significantly the total pounds per day of chlorine going into the environment.

Coal Preparation and Analysis

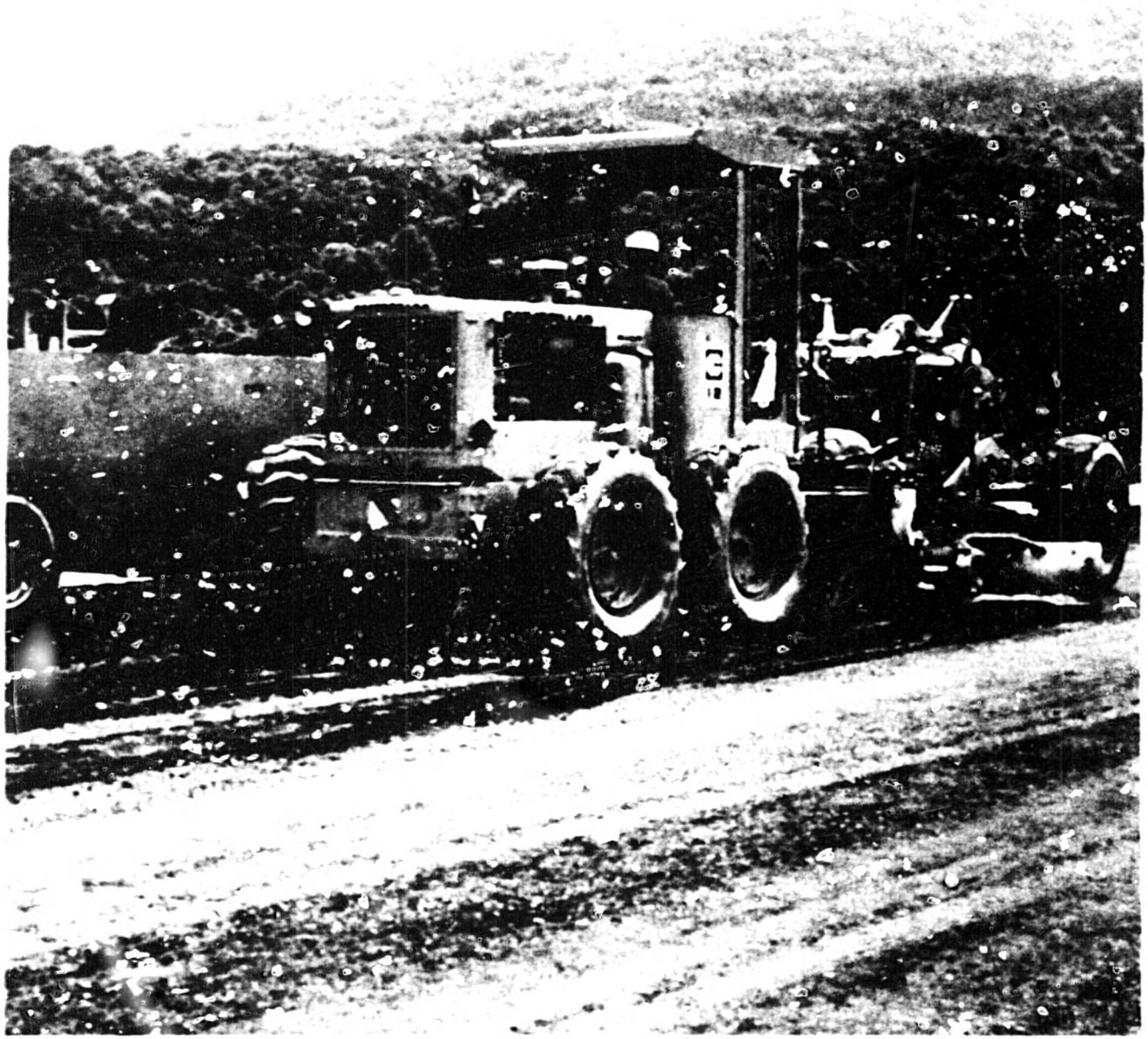
TVA is evaluating two advanced processes for fine coal cleaning. One process, high gradient magnetic separation (HGMS), will utilize a strong magnetic field to separate inorganic sulfur and other minerals from fine coal particles generated in coal cleaning. Bench-scale tests have shown the HGMS technology to be potentially more economical and able to recover more coal than present processes. The other process will utilize a technique called oil agglomeration to recover fine coal which would otherwise be lost in coal wash plant refuse streams.

Two nuclear coal analysers, Rapid Sulfur Meter (RMS) and Continuous Online Nuclear Analyzer of Coal (CONAC), will provide information for the operation of a coal-washing plant and to fine tune power plant operations. The RMS will be used at the Paradise Coal-Washing Plant to ensure an acceptable sulfur level at maximum Btu recovery. CONAC will be used to measure and evaluate coal composition and heating value to assist in optimizing power plant operation.

Power Plant Waste Utilization and Disposal

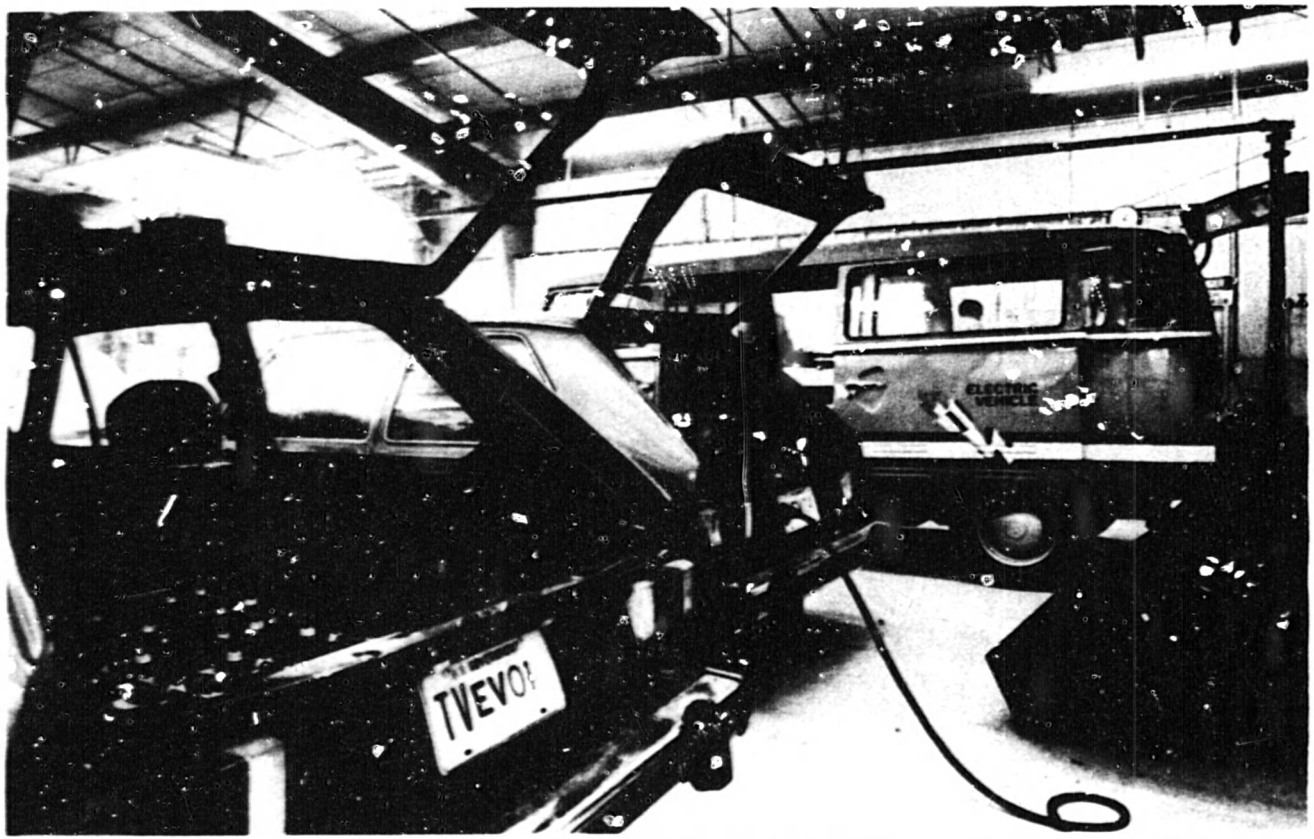
Fly ash is a major waste product of coal-burning power plants. TVA is promoting the use of lime-fly ash-aggregate (LFA) highway paving bases and subbases to the various Federal, State, and local agencies within the Tennessee Valley. A 2-mile section of new highway in Scott County in Tennessee was paved using LFA with good results. The Tennessee Department of Transportation will continue to evaluate this approach for several years. Other larger demonstrations are being undertaken.

Small-scale demonstrations showed that magnetite recovered from power plant ash performed nearly as well as the commercial product. Scaleup of this recovery process could result in a substantial saving to TVA.



A 2-mile section of new highway in Scott County, Tennessee, was paved using lime-fly ash-aggregate (LFA) with good results. A key ingredient of LFA is fly ash, a major waste product of coal-burning power plants.

A project is being conducted at the Widows Creek Steam Plant to determine the feasibility of wet-stacking, forced oxidized scrubber sludge. This process produces a gypsum, a product which is dewatered more easily than sludge and requires less land for disposal. Results from this activity will provide the engineering, operational, and environmental data needed to design full-scale disposal sites.



TVA evaluates the potential of electric vehicles to determine if their large-scale use can be compatible with consumer requirements. The investigation is carried out at the Electric Vehicle Test Facility, the only facility in the Nation solely dedicated to testing electric vehicles.

Electric Transportation

Electric transportation offers the potential for reducing the United States' dependence on petroleum fuels. It also may improve the utilization of power system generating capacity. Fleets of electric vehicles which would charge batteries at night for daytime operation would build load in TVA's offpeak hours and level out some of the swings in energy use, making the power system more efficient and helping to stabilize rates to consumers. Further evaluation is needed to assure that the large-scale use of electric vehicles can be compatible with consumer requirements.

TVA's comprehensive investigation is being carried out at the Electric Vehicle Test Facility in Chattanooga, Tennessee. The facility, built with EPRI and DOE Energy funds, is the only facility in the Nation solely dedicated to testing electric vehicles. Present activities include comparative, field testing of electric vehicle components such as new advanced lead-acid batteries, battery chargers, and battery thermal management systems. Performance testing of innovative electric vehicles is continuing, and support systems are being developed for better electric vehicle operation.

Power Factor Controllers

Since two-thirds of the electric energy generated in the United States (1,100 billion kilowatthours) is consumed by electric motors, TVA has been actively investigating technologies that would improve motor efficiency. A major effort has been concentrated on a power factor controller device which may achieve a significant saving on motors that are continuously lightly loaded or have widely varying load demands. A motor test center was set up at TVA's Electric Vehicle Test Facility, and thus far, test results indicate that power factor controllers can reduce energy use by 5 to 15 percent.

Several industrial sites, as well as one at the U.S. Post Office in Memphis, will be used to test the controllers under actual field conditions. Potential test sites have also been identified at TVA's fossil and hydro plants.

Innovative Energy Conservation Research Program

In 1980 TVA requested proposals on promising energy conservation ideas from individuals, colleges and universities, and businesses in the TVA region. Projects were selected from the private sector for support based on their potential for using energy more efficiently and for benefitting the Valley generally as well.

The objective and results of the four projects that were undertaken are as follows:

1. To develop an energy-efficient carpet-backing process which utilizes a small amount of electricity instead of large quantities of natural gas. The desired energy conservation was achieved, and carpet backings meeting industry standards were produced for a number of carpet types. The small business that conducted this work is continuing its efforts to develop further and commercialize the process.
2. To develop, construct, and test a novel system for generating electricity from heat energy normally wasted during natural gas depressurization. The system was found to be technically feasible. TVA is continuing an investigation of the economics of this and related systems.
3. To investigate a water-spray system that can improve the performance of air-conditioners. The spray system did improve the performance of the tested air-conditioner. TVA is are continuing to investigate the effects of the spray system on the air-conditioner's condenser coils.
4. To investigate the crawl space heat pump (CSHP), a system that can improve the performance of heat pumps at a low incremental cost. The CSHP demonstrated significant heating season energy and demand saving. No saving was found for the cooling season. TVA is continuing to investigate the feasibility of the CSHP for the heating season.

System in Service

Generating Capacity on September 30, 1982

TVA Hydro Plants	No. Units	Installed Capacity-kW
Appalachia	2	82,800
Blue Ridge	1	20,000
Boone	3	75,000
Chatuge	1	10,000
Cherokee	4	135,180
Chickamauga	4	120,000
Douglas	4	120,600
Fontana	3	238,500
Fort Loudoun	4	139,140
Fort Patrick Henry	2	36,000
Great Falls	2	31,860
Guntersville	4	115,200
Hiwassee	2	117,100
Kentucky	5	175,000
Melton Hill	2	72,000
Nickajack	4	103,950
Norris	2	100,800
Nottely	1	15,000
Ocoee #1	5	18,000
Ocoee #2	2	21,000
Ocoee #3	1	28,800
Pickwick	6	220,040
South Holston	1	35,000
Tims Ford	1	45,000
Watauga	2	57,600
Watts Bar	5	166,500
Wheeler	11	361,800
Wilbur	4	10,700
Wilson	21	629,840
Total	109	3,302,410

TVA Coal-Fired Plants	No. Units	Installed Capacity kW
Allen	3	990,000
Bull Run	1	950,000
Colbert	5	1,350,000
Cumberland	2	2,600,000
Gallatin	4	1,255,200
John Sevier	4	800,000
Johnsonville	10	1,485,200
Kingston	9	1,700,000
Paradise	3	2,558,200
Shawnee	10	1,750,000
Watts Bar	4	240,000
Widows Creek	8	1,968,760
Total	63	17,647,360

TVA Nuclear Plants		
Browns Ferry	3	3,456,000
Sequoyah	2	2,441,160
Total	5	5,897,160

TVA Pumped Storage		
Raccoon Mountain	4	1,530,000

TVA Combustion Turbine Plants	No. Units	Installed Capacity-kW
Allen	20	620,800
Colbert	8	476,000
Gallatin	4	325,200
Johnsonville	16	1,088,000
Total	48	2,510,000
Alcoa Dams (12)		423,715
Corps of Engineers Dams (8)		853,000
Total System in Service		32,163,645

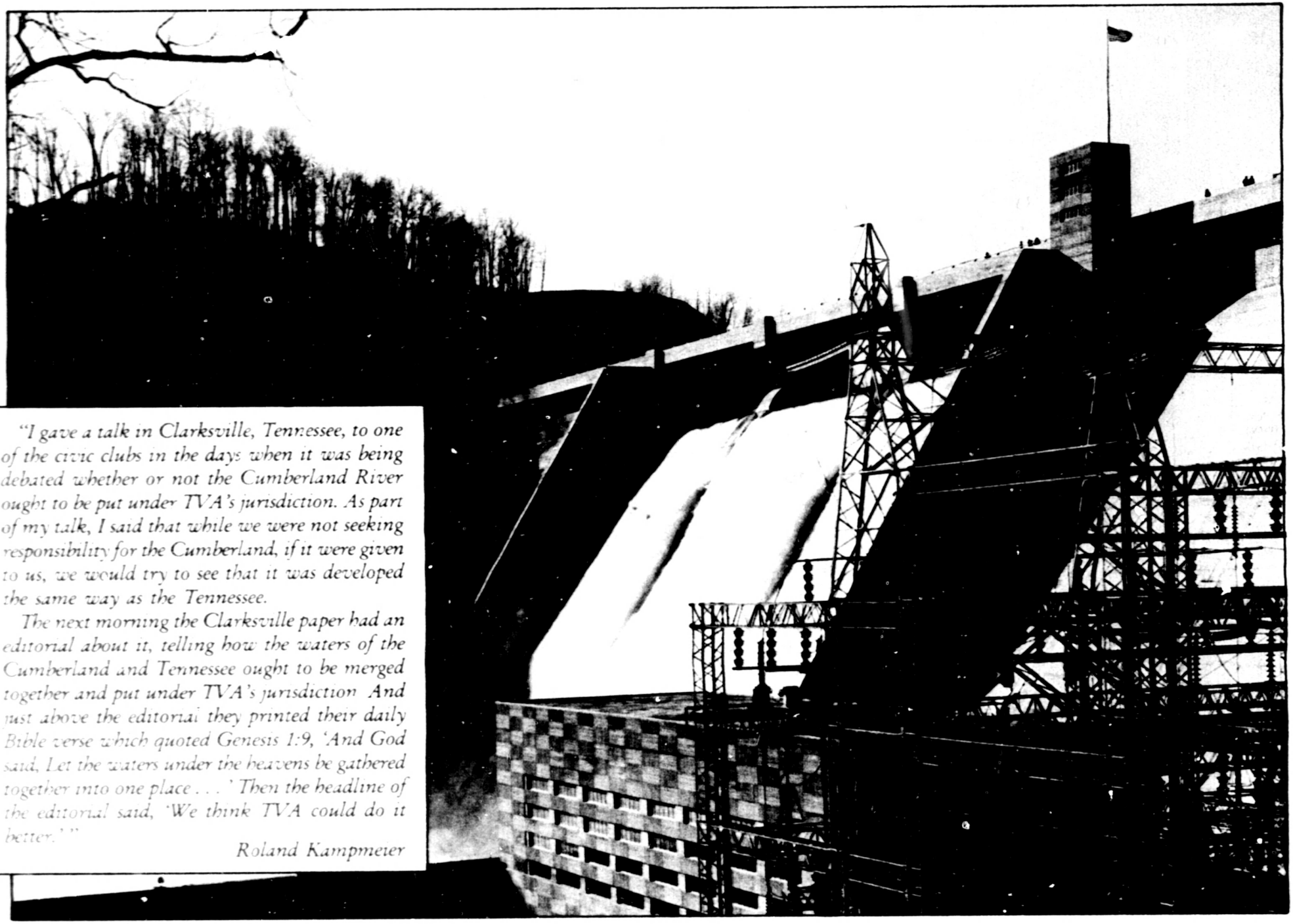
TVA
1933 - 1983

In 50 years the statistics have mounted:

— billions of kilowatthours generated
— thousands of transmission line miles set
— battles fought—technological, social, and political
— millions of lives changed

Who should tell the story, if not the people who were there, the men and women who operated the plants, strung the lines, educated the public, laid the plans, fought the battles—and won!

Eight of them—retired employees of TVA's Office of Power—speak here to reflect on the victory and the ongoing challenge that is TVA.



"I gave a talk in Clarksville, Tennessee, to one of the civic clubs in the days when it was being debated whether or not the Cumberland River ought to be put under TVA's jurisdiction. As part of my talk, I said that while we were not seeking responsibility for the Cumberland, if it were given to us, we would try to see that it was developed the same way as the Tennessee.

The next morning the Clarksville paper had an editorial about it, telling how the waters of the Cumberland and Tennessee ought to be merged together and put under TVA's jurisdiction. And just above the editorial they printed their daily Bible verse which quoted Genesis 1:9, 'And God said, Let the waters under the heavens be gathered together into one place . . .' Then the headline of the editorial said, 'We think TVA could do it better.'"

Roland Kampmeier

"TVA's finest hour was when it built the line to the last little cabin down the road."

--Mildred Alexander

Mildred Alexander was a superbly qualified home economist when she joined TVA in 1960. She had graduated from the University of Tennessee (UT) in 1941 with a degree in home economics. She worked seven years with the UT Agricultural Extension Progam, then headed up the Home Economics Department at Lambuth College in Jackson, Tennessee. She received her master's degree from UT in 1953 and returned to work in the Extension Program again.

She worked 12 years as a TVA home economist in the Western District, then moved to Chattanooga in 1972 as head home economist for TVA, heading up the Valley-wide home economics program and coordinating the work of 10 district home economists. In 1977 she was named supervisor of the Agricultural Conservation Program also, which included the work of the agricultural engineers. Through the combined programs, she directed the use of energy on the farms and in the homes throughout the Valley. She was the first women to hold that position. And in 1978 she returned to the Western District as supervisor of all energy conservation programs in that district, also a first for women. She was then responsible for directing the work of home economists, agricultural engineers, and industrial and commercial engineers. She retired in 1981.

I was employed as a member of the Electrical Demonstration Staff in Jackson, Tennessee. And I was told in my interview that we would not have "hours." We served the entire district of west Tennessee, which included the southern part of Kentucky and the northern part of Mississippi. When we were out working with consumers, we wanted to help them, and we really did not watch the clock.

We were helping people improve their lifestyles in every way possible through the efficient uses of electricity. Each family was unique, and you never knew what to anticipate. You would just wait until you got there and then do what you could for that individual family in their particular situation.

We spent time in planning home design. We knew if the houses were built well in the first place, they would be a lot more energy efficient. We did line drawings, layouts, blueprints—whatever it took to get the job done. We worked closely with builders, architects, suppliers, and educators. We coordinated our work through civic clubs, home economists groups, and churches. And we made home visits.

"I saw my work with TVA as a continuous opportunity to help people live better."

This program was conducted at the grass-roots level. One of the many rewards of the work was getting to know people and many of them became loyal friends. Of course, the consumers were the power distributors' customers, and we always worked through the distributors. We enjoyed a wonderful rapport with the people.

I worked with people who said to me, "Oh, I wish you could have known the early days." But the "early days" are still experienced by some people. When someone gets her first washing machine, that is the so-called "early days" for her—or her first [illegible] range or dishwasher or whatever.

It was a thrill to work with people who were purchasing electrical equipment for the first time. I always enjoyed seeing the ways they adapted the equipment to their needs and convenience. In fact, I saw my work with TVA as a continuous opportunity to help people live better. That never ceased to have its thrill for me. We harnessed energy that could help to lift the burden of work from the backs of the people and not only that but release them to much more fulfilling things—reading a good book, visiting the neighbors, or whatever they

wanted to do.

After I came to Chattanooga, the energy situation began to change. I had always perceived my work as encouraging the full utilization of electricity to help provide an enriching lifestyle for people. We assisted in advising all feasible applications of electricity because it was an inexpensive source of energy and had almost unlimited potential for improving the lives of people.

But when we (TVA) foresaw the energy problem, the rising prices and use tapering off, we had to "turn our programs around." We had people say, "Ah, ha! You came out here and taught us. Now we are accustomed to using electricity as widely as we can, and now you are asking us to curtail our uses." That was a real challenge. We continued to say, "No, it isn't that we have changed our philosophy. The whole situation has changed. If, when we had started assisting you, we had had the energy problems that we foresee now—the cost of supply problems—we would have adapted our programs accordingly."

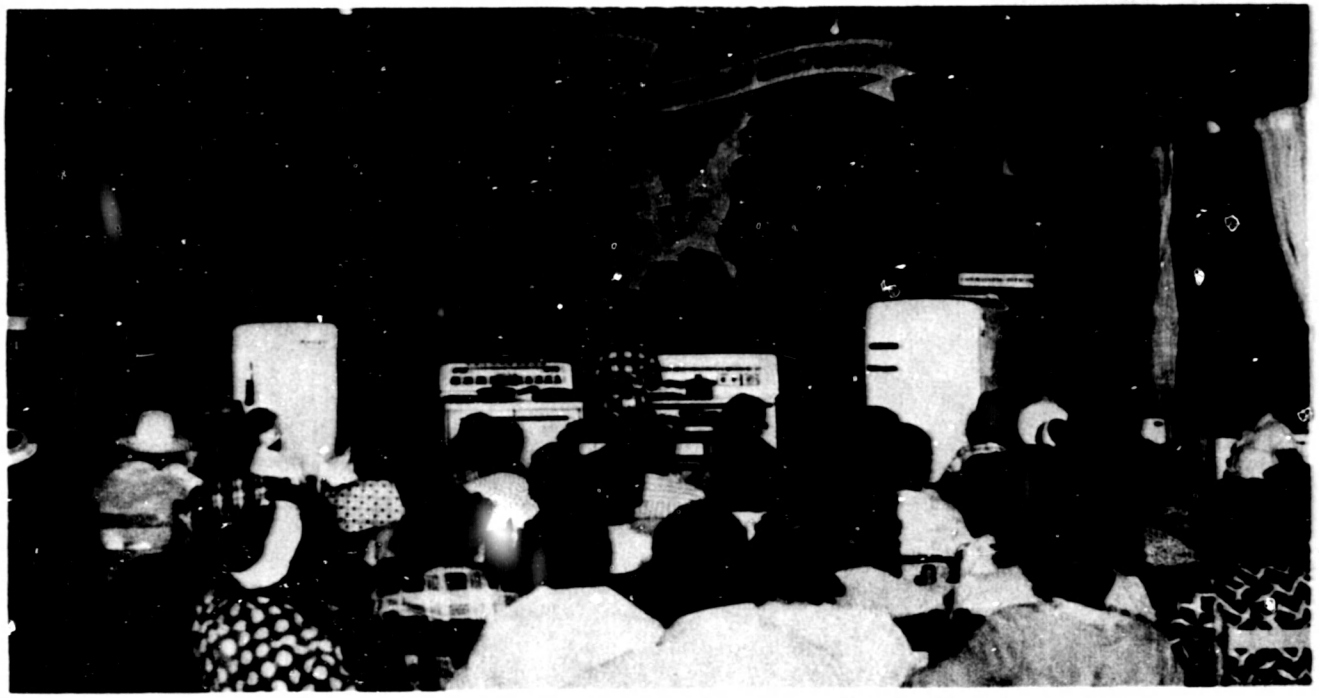
But the situation was a complete turnaround. And it was a little difficult to convince people, even some of our own people, that indeed we were facing a problem.

If people had understood better the tremendous challenge in trying to anticipate load management, trying to keep supply geared for anticipated demands, but this was an area that we simply did not work in the earlier years, and I think we should have. After I went to Chattanooga, we had some tour groups out at the Load Control Center. That clarified the situation for a lot of people. It is just an educational process. I invariably tried to lead people on to a deeper understanding of the power system, its generation, and the network of distribution.

You often heard remarks concerning "light bills." But we would take a few minutes and recount the many applications of electricity in the home and on the farm. People were often surprised by their total usage. The fact that electricity is noiseless, tasteless, and odorless, leads people to be unaware of the amount they use.

Those years were good years, too, by the way. We were bringing together the educational and industrial leaders of the country, right here in the Valley. We looked at what was coming into the market, how it could be utilized, how conservation could best be taught. TVA was very much out front.

When the Agricultural Conservation Program was brought in with Home Economics, it was a natural move. Both agriculture and home economics have their roots in the land-grant colleges across the country. The only thing new or different was me—I was the first woman to head up this kind of group.



Cooking schools conducted by TVA and distributor home economists acquainted consumers with the benefits of electric appliances.

I felt that I might have some difficulty with the situation for two reasons. One, I did not have an engineering background, and two, I was a woman and the first woman supervisor. I tried to be very open with all employees. I accepted the challenge and always told the staff, "If you have any problems, please come to me first." I was treated cordially, the staff responded well, and we worked together in the full spirit of cooperation. And I never felt that I had hurdles beyond what I have just mentioned because I was a woman.

When I came back to the District, and I was supervising home economists and agricultural engineers and commercial and industrial engineers, all programs had greatly expanded. We were into new technology such as the applications of solar energy. I still enjoyed the excellent cooperation of all the staff.

I will have to say, however, that upon my return to the District, I found myself supervising the work of 80 to 90 energy auditors, many of whom were working for power distributors in new and expanding programs. We had enthusiasm and energy—but that was quite a challenge. We went at that like trying to kill a snake. And we pulled those programs together and served the people.

What was TVA's shining hour during my career? To me, TVA's finest hour was when it built the line to the last little cabin down the road, wherever that cabin was. If it is in the mountains in some remote area and finally that family can enjoy the benefits of this harnessed energy, then that is it. If it is the last little country road, dirt road, down in the river bottom area, then that would be it. I just think it is when TVA reaches out to their ultimate consumer and allows that family, wherever they are, whomever they are, to enjoy the convenience, the comfort, the cleanliness, the improved living—all the things that electricity brings—to me that is it. □

"Time, as far as people in the country are concerned, has been reckoned from the day that the electricity came on."
--J.R. "Roddy" Huff

J. R. "Roddy" Huff passed up the opportunity to join TVA originally. He had graduated from the University of Tennessee in 1939, the year TVA acquired the Tennessee Electric Power Company. Because Huff had worked alternate quarters in the electrical laboratories of the Tennessee Electric Power Company (TEPCO) in Chattanooga, he was offered a job by TVA. He chose instead to join Pan American Airways in Miami as a radio design engineer. In 1941 he was offered a job as a field test engineer by his former department head, and he made the move to TVA. From 1942 to 1946, Huff, a reserve officer, was on active duty. In 1946 he returned to TVA as a field test engineer. In 1951 he became staff engineer for Load Control and Telemetering. In 1974 he became system control engineer with supervision over the Power System Control Center in Chattanooga and the Area Dispatching and Control Centers in Chattanooga, Knoxville, Nashville, Jackson, and Muscle Shoals. He retired in 1980.

I attended the University of Tennessee at Knoxville from 1934 to 1939, and I was a co-op student with the Tennessee Electric Power Company here in Chattanooga. I was very fortunate in the placement because I was working in the electrical laboratory of the Tennessee Electric Power Company. But when TVA acquired the Power company facilities, I was so indoctrinated with the anti-TVA philosophy that although I was offered a job with TVA, I didn't want to work for the so-and-so's. Several years later I stopped by to see a few of my old buddies at the lab, and they said, "Oh, it's not so bad." I was offered a job as a field test engineer and I took it. I stayed 39 years.

Chattanooga, the people in Chattanooga, have always been pioneers in the electric industry. And that's one of the reasons, I think, that the Office of Power ended up having its headquarters here in Chattanooga. And Chattanooga has the distinction of having had the first generating station in the South. It went into service in May 1882. The company itself was the Chattanooga Brush Electric Light Company, and it was formed by four Civil War veterans—three ex-Yankees and one Rebel. Early in the power industry, the generating plants only operated from dusk until maybe midnight. And on this first generating plant only four hands were employed. The annual payroll for all four was something like $2,500.

There were a number of pioneering efforts in this part of the country. One was the Chattanooga Steam Plant which went in service in about 1896. At the time it was one of the most modern stations in the South. The hydroelectric developments in the area were brought about by people who were in Chattanooga. The Ocoee development, for example, was placed in service in 1912, and it was promoted by the Chattanooga Railway and Light Company.

At the same time a number of local industrialists became interested in the Hales Bar project, which had a lot of advantages not only in the generation of power but in the overcoming of the navigational obstacles which existed in the Tennessee River at the time. They had a quite a contest between the project at what is now Ocoee No. One and the Hales Bar project. Whoever came online first had the franchise for supplying the city of Chattanooga. And the runner-up was sort of left out in the cold. The people at Ocoee won the race, primarily because of foundation difficulties at Hales Bar which eventually forced TVA to build the Nickajack Dam.

Another contributing factor with Chattanooga becoming the headquarters for the Office of Power was that the first dispatching office in the State was located up at Cleveland. This went into operation about 1912.

Looking back this was a tremendous step forward at that time because up until 1912 each of the towns in Tennessee had their own little steam plant. Chattanooga had one. Cleveland had. Ooltewah had one. Sweetwater had one and so did Knoxville and Nashville. And each of those steam plants operated independently to supply their loads within that particular area. And then with the advent of the hydroelectric power which started with

the Ocoee No. One project, all of these then were tied together. Because at the same time they were building this, they were building transmission lines from Chattanooga to Knoxville, over to Alcoa and down to Hales Bar and over to Nashville, and so in an incredibly short time they went from this isolated generating plant mode of operation into an interconnected system. Well with this isolated generating plant mode of operation, you didn't have to worry too much about which plant generated how much, or anything like that. But once you tied all of these together to form a power system, then you

"There was a time when you could pretty well plot the distance from TVA by the rates of the surrounding companies."

had to have a traffic cop, so to speak. Somebody to say, "you generate so much, and you generate so much, and you generate so much." So they established this dispatching office in Cleveland, and it operated up there until in the early 1930s when it was moved to Chattanooga.

Initially, electricity was used almost entirely for lighting, electric lights. And, of course, getting away from those kerosene lamps and things like that was a tremendous advantage. I used to have relatives from the country visit us and just to be able to go over there and turn on a switch on the wall to them was a fascinating aspect of city life. They didn't think the inside plumbing was all that great a thing. But to be able to flip a switch and have the light come on was, to them, tremendous.

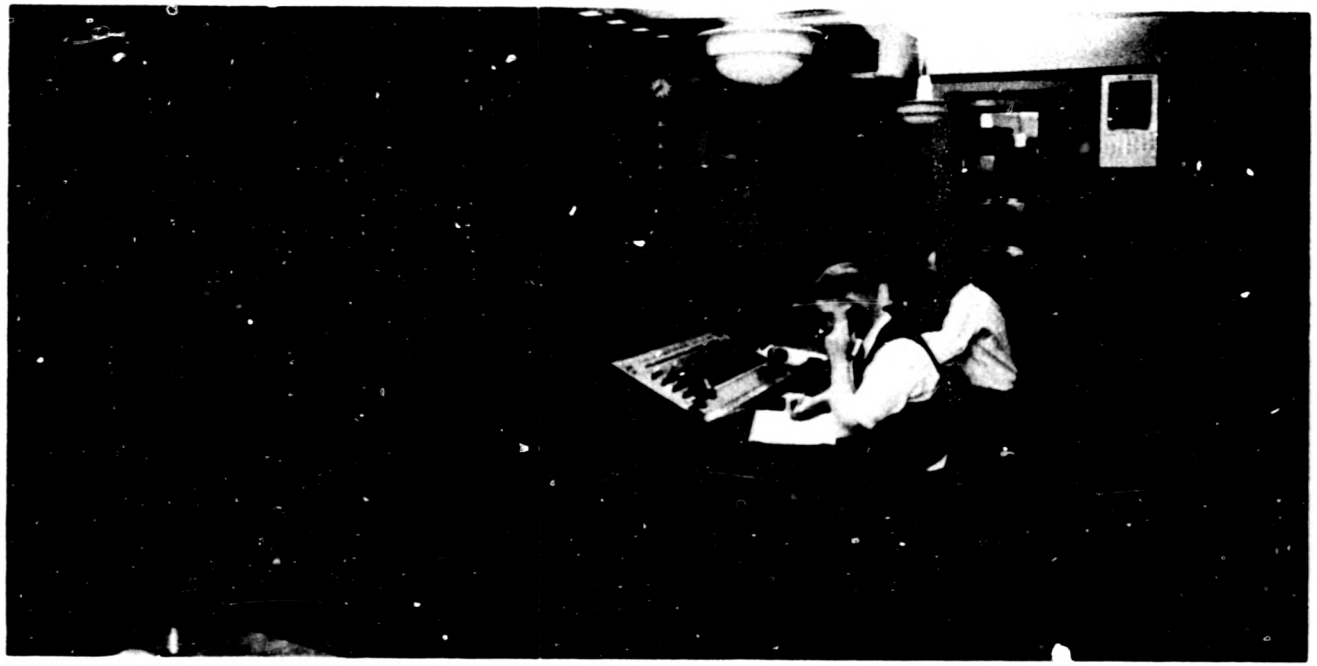
A lot of times, time, as far as people in the country are concerned, has been reckoned from the day that the electricity came on. They would see these lines coming across, but they could hardly believe that they were actually going to get electricity. And people would buy a refrigerator or a range or something like that, and quite often they would put them on the front porch.

Times have changed. Technology has changed. The old days could be pretty rugged for TVA folks. For instance, we transmit communications over the powerline circuits themselves like a radio operates. And to keep this channelized or routed the way it's supposed to go, you've got what they call wave traps which block the carrier frequency but let the power frequency go on through. Well, they've got to be tuned to the frequency of whatever you're trying to block. And, I don't know why it is, but we used to always schedule the tuning of these things in the worst weather you have ever seen. On one particular occassion I was trying to tune a line trap at Chickamauga. We had the line out of service, and we had to have it back in by 6 p.m. It was sleeting, we were working out in the open, and we couldn't get that thing to tune. It would tune on the ground, but when we put it back up in the line, it wouldn't function.

We worked and worked and worked on that all day, and finally, just before the deadline, when it looked like we were going to have to put it back like it was, we found the trouble. It was wired wrong at the factory. And we got back and I went in and they all started laughing. My hair was a solid sheet of ice.

There used to be lot s[illegible] e early days about TVA being a yardstick for the industry, and I guess we were. There was a time when you could pretty well plot the distance from TVA by the rates of the surrounding companies. Undoubtedly, we had an influence on the rate structure of the other utilities around us.

Some years ago my wife and I made a boat trip down the Nile from the Aswan Dam to Cairo. We stopped at places along the way where they had temples. And the first one we stopped at was Kom Ombo, which was dedicated to the worship of the crocodile. In my work at the Control Center we got visitors from all over the world, and I would show them around. In one instance I noticed that two of our visitors were from Kom Ombo, Egypt. So while I was talking to them, I couldn't resist the temptation to needle them a little bit about worshipping crocodiles. Somebody in the group spoke up and said [illegible], Mr. Huff, you have a sacred fish." And I said, "We do?" And he said, "Yeah, you call it the snail darter." □



TEPCO moved the area dispatching office from Cleveland to the seventh floor of the Electric Power Board building in Chattanooga in 1932. This picture, taken in 1938, shows the automatic electric diagram board, of which the Operating Department was very proud. The board was originally installed in Cleveland but was dismantled and brought to Chattanooga along with the rest of the office.

"TVA was an extremely interesting place to work right from the word 'go.'"
--Roland Kampmeier

TVA was less than three months old in August 1933, when Roland Kampmeier joined the fledgling agency. He reported to work in Colorado, because at that time, TVA's small engineering staff was being assisted on plans for Norris Dam organized by the U.S. Bureau of Reclamation located in Denver.

He moved to Knoxville in November of 1933 as a junior hydraulic engineer in what was being organized as the General Engineering and Geology Division. In 1939 he left TVA for two years to head up the Department of Hydraulic Engineering at the University of Tennessee. He returned to TVA in 1941 as chief of the Power Economics Division in Chattanooga. In 1947 he became Director of Power Utilization, and in 1950 Assistant Manager of Power. He also directed the Division of Power Supply and had responsibilities for financial planning and fuels supply. He left TVA in 1962 to be a free-lance consultant

I arrived in Knoxville on a very gloomy November wintry day in 1933. There was soot falling as well as rain. The main street of Knoxville was largely lined with shops that were either closed or doing very little business. This was the middle of the Great Depression.

A similar impression was gained by driving through the countryside. That was before the farmers of the Valley had begun using cover crops to any substantial degree so that when you came through east Tennessee in November you saw a lot of bare eroded hills. Many of the homes one could call shacks. The people were shabbily dressed, patch on patch. Everything looked poor. It was poor. Per capita income was less than $200 a year, very low, less than half the depression-level national average.

This silhouette became a sign of prosperity as rural areas, long deprived of power, were "electrified" with new hope and opportunity.

But, TVA was an extremely interesting place to work right from the word "go." Working with some of the seasoned engineers coming in from all parts of the country to take jobs in this exciting new enterprise was an education such as a young engineer seldom has.

I think the most fulfilling part of my work was during the period from 1941 to 1961 when the use of power expanded so very rapidly—first for the war effort and then for peacetime economic development. We had the satisfaction of being able to provide a growing power supply fast enough to keep up with that growing use and in the process bring the cost to the consumers down in spite of a period of very rapid inflation after World War II.

We were changing from a predominantly hydroelec

tric system with unusually low power cost to one that was predominantly steam-powered with some inherently higher costs. Before that period was over, we were also moving into self-financing for TVA, so we had to persuade investors that TVA was a good place to put their money. In the face of those factors that tended to push our costs up, being able to hold down the cost per kilowatthour while expanding the power output tenfold during a 20-year period was an extremely satisfying experience.

Today, when we have a very high level of energy consumption, tempered by desirable conservation programs, not many of us remember how important the growth in use of electricity was to the people of the region back in the 1940s and 1950s.

Even by 1945 at the end of World War II, if you had found yourself at some random rural spot in the Valley and walked to the nearest house, the chances would have been about four to one that the family living there was without electric service. They had no running water, no bathroom, no electric lights, no refrigerator. Those town homes, which had electricity when TVA began in 1933, used about 50 kilowatthours a month, less energy than most of our homes now use in two days. There were no televisions, no water heaters, no electric ranges, no electric heat or air-conditioning, probably not even electric fans, no automatic washing machines, or kitchen appliances.

Abundant TVA power at low cost made possible not only the electrification of rural homes and the purchase of electrical appliances for town and country dwellings but many other benefits. The schools could be lighted, the stores air-conditioned. The region began to attact many more industries, large and small.

The most painful assignment that I had in all my years in TVA was in connection with the Dixon-Yates project. Mr. Dixon, head of the Middle South System and Mr. Yates, head of the Southern Company System, proposed to build a power plant across the Mississippi River from Memphis, feed power into Memphis and relieve TVA of some of its power demands. We were supposed to reflect this in our arrangements with the Atomic Energy Commission, to whom we were delivering power at Paducah and Oak Ridge. The President, through the Bureau of the Budget, directed TVA to enter into the Dixon-Yates arrangements with the Atomic Energy Commission.

I represented TVA in unpleasant discussions with the Bureau of the Budget, the Atomic Energy Commission, and the private utilities, over a period of many months. Then the city of Memphis decided to build its own power plant and that squelched the Dixon-Yates scheme.

"The chances would have been about four to one that the family living there was without electric service."

TVA has been criticized over the years. However, it is new for TVA to be criticized by the people whom it is trying to serve. In the earlier years, we were criticized by politicians from other parts of the country who used the old saw that, "the Tennessee River flows through seven states and drains 48." We had to overcome that sort of criticism by facts and figures and logic and proof.

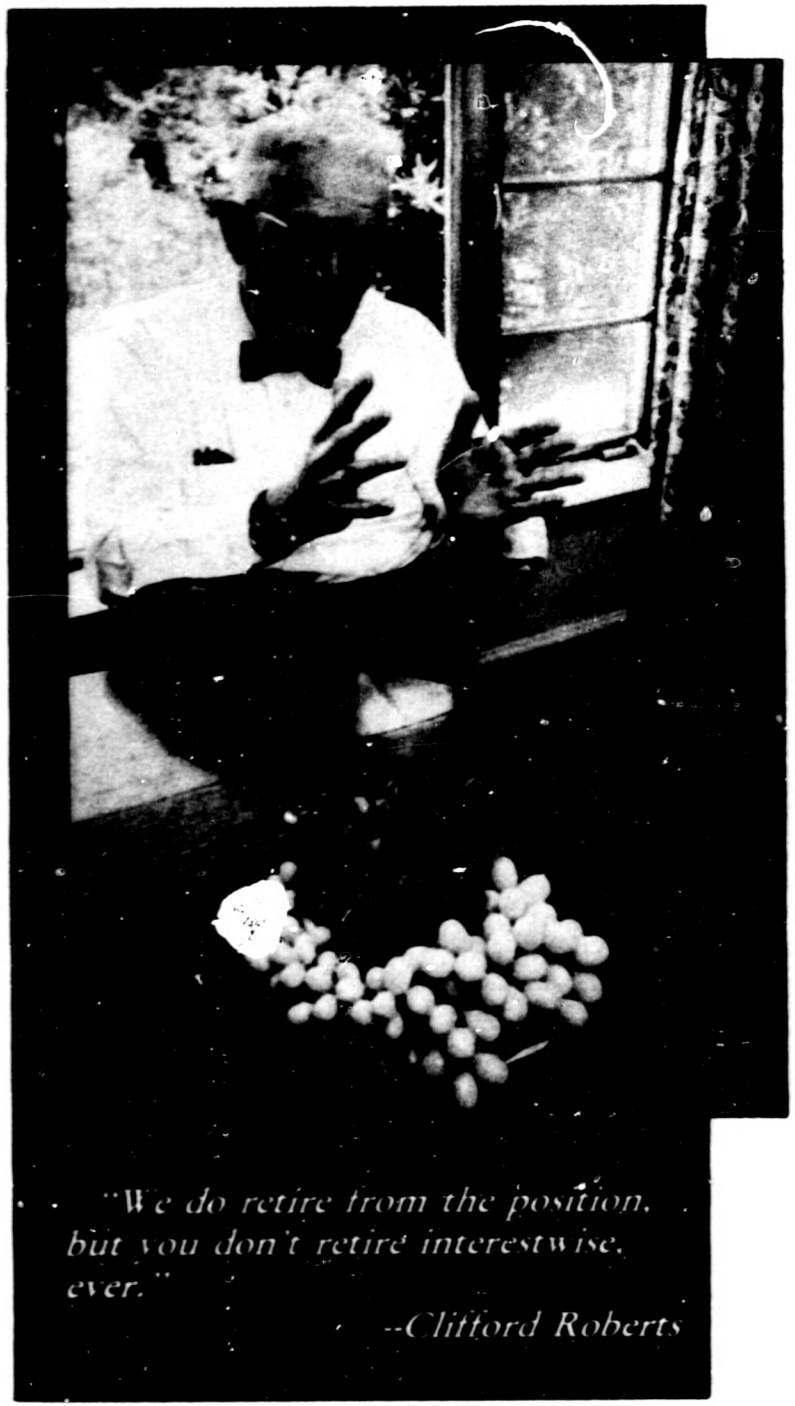
Criticism is part of the game. But it did hurt when the people of the area began to complain that TVA wasn't doing its job as they thought it should.

The complaint was provoked by rising electric rates—yet rates, even after going up sharply, are much lower today in real costs—adjusted for inflation—than when TVA began. The value of electricity was so great that people, recognizing that value, had increased their use so much that when the price had to rise, they began noticing how big their electric bills had become.

We always felt that people ought not to waste electricity. I have never been one for leaving a light on in a room with no one in it or leaving heat on in rooms not being used. We always encouraged people not to waste electricity. We tried to say that electricity should not be used for a purpose for which it costs more than it is worth. We did point out the fact that for most purposes, electricity is worth a lot more than it costs.

By the early 1960s, the pace of my work was beginning to ease a little, and I decided to shift to consulting work. I had been impressed by the extent to which TVA's success was attracting the interest of developing nations around the world. We had thousands of visitors who wanted to see what we had done and to ask how we did it. TVA always welcomes such visitors. I decided to try visiting the countries which wished to apply TVA experience. I found that many of their problems were not so different from ones I had faced in TVA. □

By 1951, TVA power was turning night into day in small towns across the Valley.



"We do retire from the position, but you don't retire interestwise, ever."

--Clifford Roberts

The mechanics of running a power system, making it go, making all the cogs and wheels and relays and switchgear (all the pieces of material run together) and not just making them run but reinventing and innovating to make them run better, save time, save money, save heat, save pressure—those are the things that the public rarely sees and that maybe only an engineer will understand. And those were the things that made Clifford Roberts' job "fun."

Graduating from Georgia Tech in 1933 with a degree in electrical engineering, Roberts joined TVA the same year as a track gang laborer. He worked as a junior switchboard operator as an assistant switchboard operator at Wilson Dam and the old Sheffield Steam Plant for four years. He worked at Pickwick Dam as a switchboard operator and then senior switchboard operator. The year 1941 found him in Chattanooga as an assistant personnel officer. From 1942 through 1955 he worked as an electrical engineer in the Power Production Branch. Then he became supervisor of the Electrical Engineering Section of the Power Production Branch. In 1960 he was named supervisor of the Plant Electrical Section, in 1961 plant superintendent at Wilson Hydro and Steam Plants, in 1963 assistant to the chief of the Power Plant Maintenance Branch in the Division of Power Production, and in 1965 chief of the Hydroelectric Generating Branch.

He retired January 31, 1976.

I got a call from Norman Huff, who was the personnel supervisor at Muscle Shoals at that time, to come out and talk with him. He said, "I have three jobs that you can have your choice of—one is personnel officer, one is a guard (that's in the Division of Reservoir Properties as it was known at that time), and the other one is a junior operator at Wilson Hydro and Sheffield Steam Plants."

Well the junior operator appealed to me. I don't remember the relative rates of pay, but I picked that over the other two and went to work on May 1, 1934, in Wilson Hydro.

One of my friends once told somebody else that "Clifford Roberts never worked a day in his life." That's because everything I did was enjoyable. And I can't pick one over the other as being the most enjoyable. Of course there's pleasure in recommending something and having it accepted and put into practice. And I had a few of those and you might say those were little high points. But, honestly I just plain enjoyed the 42 years I spent with the outfit. In fact, to go back in time, I'd do it again.

"TVA is the best organization I know of to work for."

My work was with people. I was not involved in any way, shape, or form with the growing pains of TVA or its arguments with private power and in legalities—the suits and countersuits—all of the stuff that took place at the time.

I was involved in operations the whole time—operations and maintenance of the equipment in the hydro plants but also in the steam plants.

In my tenure as head of the Electrical Section, we had both steam and hydro problems. For instance, the steam plants use hydrogen gas in the generators. And initially this hydrogen gas was transported into the plant in steel bottles and hooked up to a manifold. There were so many crafts involved in the installation and removal of the bottles, hooking them to the line, checking out the electrical circuits. Frankly, all the crafts in the plants, pipefitters, steam fitters, the machinists, and the electricians were all involved, and they were constantly embroiled in who was supposed to do what. One of our section originated the idea of storing that gas in large trucks and hauling it to the site and hooking it to a mani-

fold outside, which very much reduced the cost of gas handling. With the gas outside there was just a simple connection to make. This was accepted by our division and used as a method of gassing the generators at all the subsequent plants.

Another little item was the use of a Weston thermocouple actuated relay to trip the steam units. That's one I cooked up myself along with the head of the mechanical section who was needing something to help out in case of thrust bearing failure on a steam generator.

When the thrust failed it could be very expensive and very destructive to the turbine portion of the unit. So we developed this little relay scheme, and the mechanical people developed a method of installing it so that when the thrust became sharply in danger of failing, the unit would be immediately tripped and taken out of service, saving a pretty good pot of money as well as downtime on the unit. That, as far as I know, has been adopted at all of the steam plants as a protective device on the units.

We also developed in our section a starting and running circuit and protection circuit for the control air compressors so that they would not only furnish a continuous source of control air for the turbine generators installed in a plant but would protect themselves in case of trouble internally to the control air compressors. That was adopted as a standard device, and, as far as I know, that circuit is still used in all of the steam plants on the control air compressors.

These are small items, you know, but they are worth a lot of money.

I was also involved in the early days and practically throughout my career in the training program for student generator plant operators in the hydro plants, either as an instructor or as a representative of my boss on the various committees such as the accrediting committee and the joint committee for the accreditation of those operators. In other words, through the training program, we saw to it that they were capable of handling the job before they were put on it.

When I went to Pickwick, we didn't have any such things as overtime or payment for overtime. We had the rudiments of a training program in progress then for student operators as well as for operators who were actually responsible for shifts at that time. Well, we, on our own time, taught a class of student operators. I didn't receive anything for it and didn't expect to receive anything for it. It was fun to do it. It was enjoyable to see them assimilate the information that I tried to convey to them. And that was payment enough in itself. As I said, we didn't have any overtime at that time. Many and many a night after the people had worked their shifts we would come out to the plant and pull the drawings on the equipment before it was in service, sit down, and pore over those things and learn how to handle that equipment efficiently and safely. And we didn't expect anything for it. And we didn't get anything for it, except the pleasure of knowing that we understood the equipment and would be able to operate it without damage.

Some of the things I'm sort of happy about, which are still continuing, are two little jobs in the hydro plants. I was a member of the IEEE hydroelectric subcommittee and I got some ideas from what other people were doing. We had been suffering failures of stator coils in hydro units over a long period of time. I decided we had better start rewinding those machines. We had roughly 100 units at the 29 hydro plants. So we started. And we have done about four replacements a year. We have been able to increase the capacity of these windings for a very small unit cost per kilowatt. We would take out the old winding at 30 megawatts and maybe put back a new winding that carried 35 megawatts. That program is still in progress.

While I was branch chief, we started putting lift pumps on thrust bearings on hydro units so that starting and stopping would not damage the faces of the bearing metal. We tried to get the manufacturers to do that for us. They gave us prices that were outrageous. We proceeded to do it ourselves for about one-third to one-fifth of what they were asking for the job. We devised our own system and began to install it before I left, and I see they've just about completed that program. So these things are fun. That's all they are—just pure fun.

Right today, electricity, along with water, is one of the cheapest commodities we have. Nobody will believe that because they are so used to paying seven and one-half mills per kilowatthour for residential use. Over so many years they came so cheaply. But, my gosh, when coal went out the roof and other fossil fuels went out the roof, rates have gone up 300-400 percent. What else has gone up? When I was at Pickwick, I was paying 25 cents a pound for T-bone steak. What is it today? At least 10 times that. Are we paying 10 times more for electricity? We certainly are not.

We do retire from the position, but you don't retire interestwise, ever. I talk to the boys from time to time about things. You know a generator at Gallatin is being replaced with a supercooled rotor unit—entirely different sort of winding configuration as well as the plus four degrees Kelvin temperature the machine rotor is going to have—a "way out" type of unit. I presume the object is to see if this could be more economical than anything else.

TVA is the best organization I know of to work for. It was in line with the type of work that I knew I would enjoy when I began. It continued so until they fired me for getting too old. And, if I had it to do over, I'd do it again. I'd try to get in the same type of work as I was in. Hydro has been my love ever since I started and would continue to be if I were able to go back to work.□

Through the years, TVA provided good jobs along with the electric power that developed the Valley.

"It's a thrilling experience to put a unit on the line."

--A. T. Secor

A. T. Secor sort of "came along with the purchase" when TVA acquired Kentucky/Tennessee Light and Power Company in 1942. And TVA acquired a more than lifelong "private power" man in Secor. The son of a man who had made a career out of operating industrial power plants, Secor was graduated from Pennsylvania State University in 1925 with a degree in mechanical engineering. He spent 17 years with the Associated Gas and Electric System, owners of Metropolitan Edison, Florida Public Service, and other properties including Kentucky/Tennessee Light and Power Company.

As a mechanical engineer in Power Production, one of his TVA jobs was to scout western Tennessee and western Kentucky for power plant sites. The ensuing report resulted in the selection of the site of the Johnsonville Steam Plant and Secor asked for and got the job of plant superintendent in 1950 when the plant was under construction. He stayed long enough to start up the first four units and moved on in 1951 to Paducah to start up Shawnee. He stayed nine years, moving to Kingston in 1960 and then to Chattanooga as chief of the Steam Electric Generating Branch in 1961.

Secor retired from TVA in 1966 at the mandatory retirement age of 65. Unwilling to leave the power industry, he went on to work for South Carolina Public Service Authority (Santee Cooper), retiring as director of Production and Thermal Construction in 1972.

My dad worked all his life in industrial power plants. He was a man with an eighth grade education but a very well-educated man. I was visiting at home one time, long before I ever even thought about coming with TVA. And out of the clear blue he said, "You know, son, I believe you ought to look into that TVA thing." He said, "I think it's the coming thing."

When TVA was acquiring the Kentucky/Tennessee properties, I was assigned as liaison with the TVA group as they visited the various municipals, the town councils, and the farmers groups to sell them on the idea of taking over these properties as their own, under their own ownership. I was assigned to travel with the group because I knew most of the people in these towns. That's how I got to know TVA people.

Of course, TVA could not really take over retail properties. They were just recommending that for this municipality the boundary lines would be here; for this potential co-op the boundary lines would be there.

In due course the settlement came, I think it was in a hotel in Louisville. All the representatives of the municipals and the potential co-ops and the Associated officials and TVA were there. TVA handed the Associated a check. So for about a few minutes, TVA owned everything. And then the future municipals and co-ops handed their checks to TVA and they owned them.

One of the things I would like to dwell on just a little is TVA's labor relations and the formulation and activities of the co-op committees. To me it was an idea that needed developing. My feelings about people coincide with my relations with the co-op committees, because in my dealing with people, particularly as plant superintendent, I always felt that everyone in that plant knew a little something more about something than I did.

"You know, son, I believe you ought to look into that TVA thing." He says, "I think it's the coming thing."

I had what I felt was a most successful operation at Shawnee because I made the most of the abilities of the people that were in the plant.

One of the things that I had considerable success with at Shawnee was a motto I had for folks that came to me with ideas—"If it has half a lick of sense, let's try it."

I might mention the Kemp dryers. The Kemp dryers dry the air going to the control devices that control fans on the outside of the building. They are subject to freezing and putting out of business if the air is not completely dry. Well, we saw the need of an additional Kemp dryer. It is only a little outfit. It doesn't amount to much. So I sent in a requisition to Chattanooga for an additional Kemp dryer. I got turned down flatter than a flitter.

Well, my boys said, "Mr. Secor, we can't get along without a second Kemp dryer." I said, "All right. What do you want to do." They said, "We'll build one." I said, "All right, hop to it."

So came the winter and the freeze developed and Kingston started losing units, and we were just hopping right along. Their controls were freezing up on the outside. And Marshall Johnson (then chief of the Steam Electric Generation Branch) got on the line with Massey, the Operations Supervisor, and said, "How come your boys are keeping your units on the line and Kingston is losing theirs?" Massey came to me and he said, "What the hell am I going to tell him?" I said, "Tell him, by God, you built a new Kemp dryer and saved our bacon."

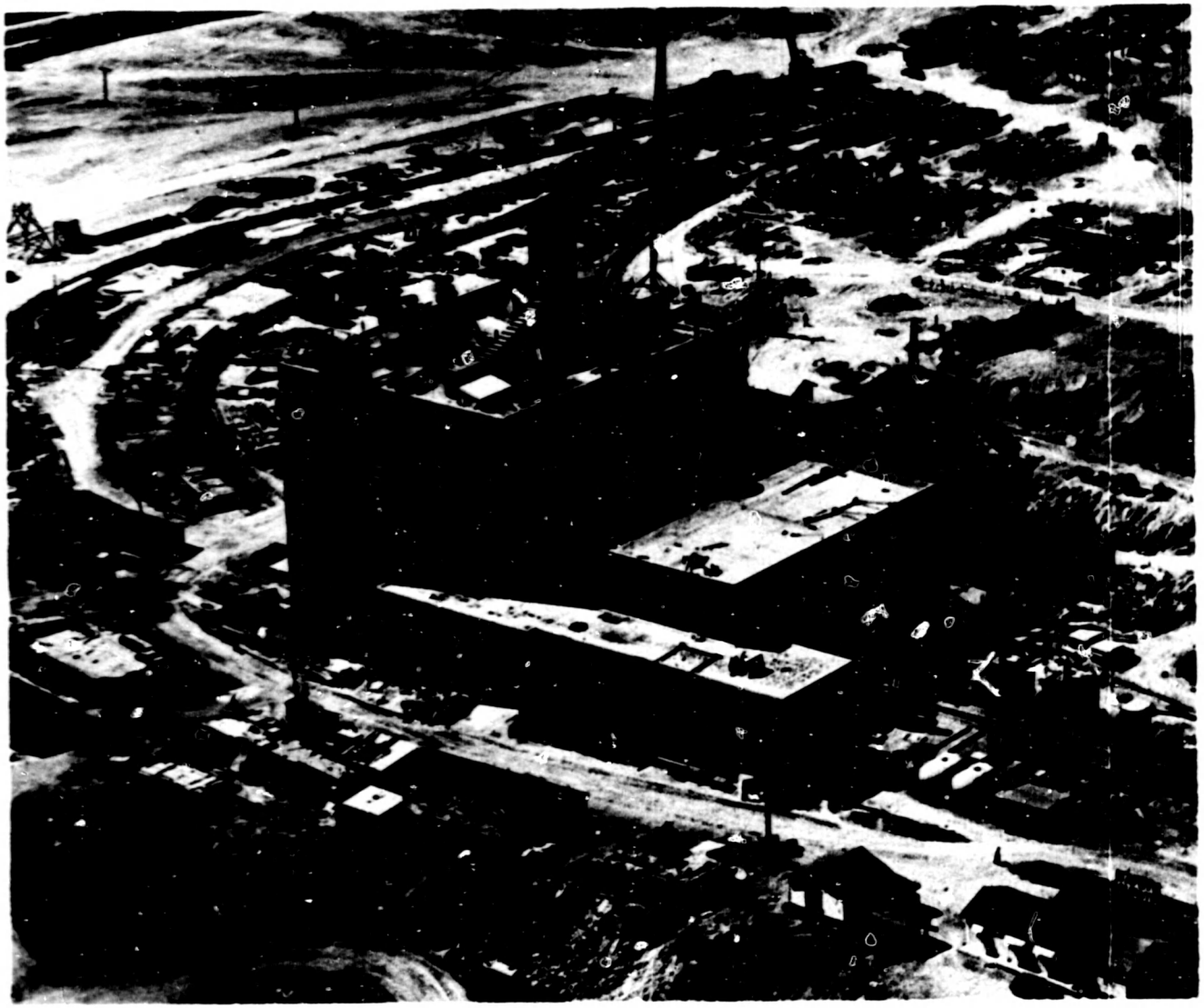
One of the problems in the plants was, in plain words, fear of Chattanooga—"Don't make the wrong move." Well, I was not burdened with that, having worked in the Chattanooga office. So my admonition to my staff was, "Do what you have to do if it looks like it needs to be done."

When I got ready to leave Kingston Steam Plant to come to Chattanooga as chief of the Steam Electric Generating Branch, one of my dear friends said "You always said, 'Don't pay too much attention to those SOBs in Chattanooga.' " He said. "What are you going to do when you become one of them?"

Well, I just had a great time running the steam plants, encouraging the people to be aggressive, to do what they're supposed to do, when they think they ought to do it, to run the steam plants as I would have run them if I had been there.

There are some things I really miss, like starting up a plant, things that occur. It goes for days and there'll be this crowd working here and this crowd working there, this crowd trying to finish this and this one trying to work that out. And it goes on and eventually you think you are about to put the unit on the line or start it rolling, and it doesn't happen. Days go into nights, and you wind up catching a little shuteye on the concrete floor or winding up on a desk. But eventually the great moment comes, when it rolls and it's a thrilling experience. No matter if you start up a hundred, it would be the same every time. It's a thrilling experience to put a unit on the line.

To me, TVA was a magnificent experience. I never went to work in the morning. It wasn't work. I went in the morning like I came home at night. I've never pictured myself as "working" in the power industry. It was just a part of me. I did it. And thoroughly enjoyed it.□



Bull Run Steam Plant began generating electric power in February 1966 and began generating an enviable record of achievement as well: 1975, world's most efficient coal-fired power plant; 1978, best heat rate in the Nation; 1979, among the top 10 plants in heat rate in the Nation; 1980, most generation in one year for any TVA fossil unit.

"The two most important things in the world—one of them is the saving of souls as the evangelists say—the second is the power business."

--E. Floyd Thomas

E. Floyd Thomas joined TVA as an engineering aide in 1939. His first job was inventorying properties acquired from the Tennessee Electric Power Company (TEPCO) at the old Hales Bar Dam and Steam Plant.

He served as assistant mechanical engineer for operations at Hales Bar and at the Ocoee plants. He later was made assistant superintendent of the Nashville Steam Plant. He later worked as assistant superintendent at Wilson Dam, assistant superintendent at Watts Bar Steam and Hydro Plants, asssistant and then superintendent at Johnsonville Steam Plant.

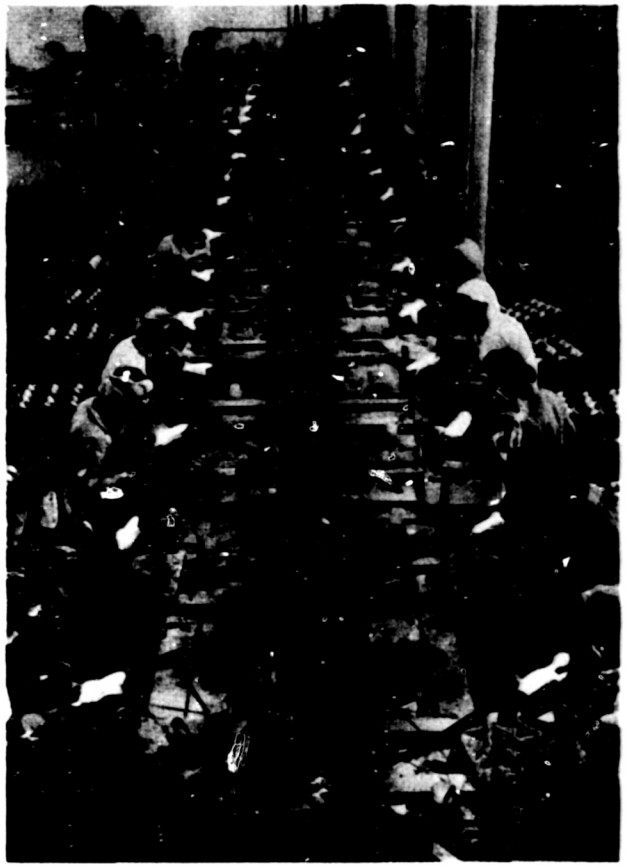
In 1960 Thomas was named assistant director of Power Production and in 1962 director of Power Production. In 1976 he became danager of Power Operations, supervising the Divisions of Fossil and Hydro Power, Nuclear Power, Power Systems Operations, and the Operations Planning and Maintenance Coordination Staffs.

He retired in 1982.

Back in, oh, prior to May 18, 1933, north Alabama was one of the worst hit sections of the country as far as the Depression was concerned. I guess if you wanted somebody lean and mean, the people of north Alabama should have been awfully mean because they were lean. Jobs were hard to find. I know that as I grew up in junior high school and high school, I had seen some of the worst of the Depression. My father was a dentist, and I remember that he would pull a tooth for maybe a dozen eggs or a make a set of teeth for a ham. There were no jobs. Agriculture was about all there was then, and cotton was king.

Then January 18, 1933, Roosevelt announced his plans for TVA. I remember as a junior in high school, I was on top of State National Bank in Florence at the corner of Tennessee and Court Streets. Roosevelt rolled up in an open car with the guy who really was the father of TVA, Senator Norris. I wondered then what it was all about. I later was to find out more and more what effect the TVA was going to have on north Alabama and the whole Tennessee Valley region and, in turn, the entire Nation.

The stage had been set for a long time for something to happen in north Alabama. As early as 1907, there had been an engineering study of the river because this end of the Tennessee had been cut off by a terrible drop through the Muscle Shoals section of the river where



Jobs were a major benefit of the industrial development which followed hard on the heels of TVA. Here workers at Southeastern Metals Company in Decatur, Alabama, assemble lamps.

there was a 140-foot drop in less than 30 miles. At times there was no way of getting boats through. I remember as a kid in junior high school I walked across the river to Seven Mile Island, and it never did get above my knees. That's how dry it got sometimes in the summertime.

"TVA was going to become the starting point of something great for the Valley."

In the fall of 1917, because of World War I, they appropriated monies to build the nitrate plant at Muscle Shoals, which is now the fertilizer works. They simultaneously built Nitrate Plant No. 1 and No. 2. There were up to 25,000 people who worked on construction of those plants, and it was a huge hub of activity. To supply electricity on an interim basis, they built quickly two steam plants, and both were placed in operation. In 1981 the war was over before Wilson Hydro Plant was finished, and became white elephants—the nitrate plants, as well as the hydro plant. What are you going to do with them? The Depression came along in 1928-1929 and still nothing was being done with them.

The cost of electricity to the people in north Alabama, and I didn't know this until later, was ten cents a kilowatthour. Ten cents an hour—more than what you would pay in New York City today. Do you know what Alabama Power Company was paying for that power from the U.S. Engineers, and they were getting it less than five miles away at Wilson Dam? Three mills. That's over a 3,000-percent profit on sales. That was something!

The concentration of industrial potential was there; American Cynamide Company and Ford Motor Company were interested. Henry Ford wanted to build another Ruhr Valley there and probably would have. But, Senator Norris was the person who saw the potential of that area, not only for that particular area but for the whole Valley in the development of the river. He convinced President Elect Roosevelt. By the fall of 1933, we had a TVA Board, and TVA started doing something. TVA was going to become the starting point of something great for the Valley. First construction was

Annual meetings frequently doubled as farming "fairs" where TVA and distributors touted the advantages of electric living. This meeting took place at Sand Mountain.

at Norris Dam, which followed Wilson Dam (acquired with The Act); then there was Wheeler, then Pickwick, and on down . . . Guntersville, Chickamauga, etc. I had the opportunity of either knowing or working with all the first superintendents of those plants and on down through the years right until I left TVA in 1982. It was great to be a part of TVA.

Well, the river was being developed. The fertilizer works were being put to work, conservation was being carried out. There was so much being done for all of the Valley. Malaria was conquered. As a kid I used to have malaria every summer, the kind where you had a chill either every other day or every third day with regularity. It was something else. TVA completely eliminated malaria with their programs. But all of these extra things were done with congressional appropriations; we don't get appropriations for such things today. Everybody's looking for something out of the power fund, and without these appropriations, this runs up the price of electricity.

The new dams were being built for various needs, such as, World War II, when Oak Ridge was being built, but no one knew what for. Of course, it was the development of the atom and tremendous amounts of power were required.

The struggle went on concerning dam building, even within the State of Tennessee. Senator McKellar was bucking and trying to stop the building of Douglas Dam. Roosevelt and those in his administration finally convinced McKellar to back down. TVA was able to build

that dam from start to finish in less than 13 months. All of these things were great. And as they were built and developed, we operators took them over.

Well, this was fine. But back before we had this hydro potential, back before TVA existed, we had the ten cent per kilowatthour which stopped any industry from coming in. Then all of a sudden the TVA had power, power, power—hydro power which as late as 1946 we were selling for three mills a kilowatthour to industry. Residential rates were around 17 mills—1.7 cents a kilowatthour. In 1966 they had come down to about a 2:1 ratio (residential to industrial). The price of electricity had gone below one cent a kilowatthour for residences and yet industry still had power for half of that. This certainly brought in industry.

When you have an energy intensive industries such as Reynolds, Alcoa, Monsanto, and others, there are a lot of jobs. Today there are people who think, "Well we'll get away from energy intensive industries." When you do, you lose a lot of jobs. Those energy intensive industries, good or bad, create jobs. This is one thing that helped the Valley and the Valley States to grow because there was a plentiful supply of electricity at an attractive price.

"I guess if you wanted somebody lean and mean, the people of north Alabama should have been awfully mean because they were lean."

By 1950 all the hydro plants that could be built on the reservoirs and on the mainstreams had been completed, and additional units added here and there. Still, there was electrical load growth in the Valley, seven to ten percent each year—growth of electricity peaks and, in turn, use. So we had to have new generating capacity. In 1950 we started building steam plants.

Even with the coming of the coal-fired plants such as Johnsonville, Shawnee, Widows Creek, etc., we had low generating costs because we were able to buy coal at very low prices.

Then later it looked like it was going to be impossible to get coal. The price of coal was rapidly going up. The problems of coping with air pollution were becoming very, very significant. In fact it looked like the cost of trying to cope with that part of it would cost more than building a new plant. We decided to go nuclear. At the time that was great, because nuclear plants could be built for practically the same price as coal plants. There's not a lot of difference in the original price of Browns Ferry Nuclear Plant and Cumberland Steam Plant.

In the 1950s, we went from a primary hydro system to a fossil dominated system. Fossil soon produced 70 percent of our total generation. Soon all new generating construction was nuclear. As we looked at our sources of generation, it looked like we were in pretty good shape. We planned for 17 nuclear units in seven plants. All of a sudden the bottom dropped out of the market for electricity. TVA started backing off on nuclear construction. The growth became negative. Here we were with plans for constructing new nuclear plants, and instead of having a positive growth, we have a negative growth. So we began shutting down new construction.

Through the years we have had some of the best operations of our coal plants compared with any in the United States. We have had on two occasions the most efficient fossil-fired plant in the world at Bull Run. TVA's fossil plants had the best heat rate and lowest total production costs, consistently rated in the top three major systems, usually in first position, until the Browns Ferry Nuclear Plant fire.

TVA's nuclear plants now lead the Nation in availability and costs of generation.

I think that we have been in a recession that has cut back on the use of electricity. However, electricity will become even more important in the future. I think we're going to have all we can do to produce enough power in the late 1980s.

There is another important feature of nuclear power for the future. On a TV program I witnessed recently, an astronaut was talking about his recent experiences. This guy really got my attention when he said, "In speaking of the atmosphere, we're casting a great pall all over outer space." This bothered me. And how are we doing it? We are doing it with cars. We're doing it with fireplaces. We're doing it with industrial plants. One of the ways to control this problem is with the cleanest production, next to hydro, that we've got, that is nuclear power.

I think that people in the U.S. should take a hard look at what is going on in the rest of the world. The French have already built their Phoenix breeder reactor and now have their Super Phoenix many steps beyond our Clinch River Breeder Reactor plant. The 1,000-megawatt Super Phoenix unit is going into service soon. Even the Russians have a 350-megawatt breeder reactor. The Germans have a breeder. The British have a breeder, and yet we have not been able to move forward in this area. Sooner or later we are going to have to have the breeder to go with our conventional nuclear plants. We've got the know-how. We know how to do it, and nuclear is by necessity going to be one of the keys to future energy needs. There is no doubt about it.

I think that TVA is spawning ground for gifted people who have the ability to go out there and get the job done. I guess the one thing that I've enjoyed most with TVA is seeing people grow through training and development where their full potential could be reached, either with us or with somebody else.

TVA is a great organization. TVA is bigger than any one man. And I think that the composite TVA whose greatest value is its people will continue to be a great organization—a service organization that can pay its way and make this place a better place than it was before. It cannot become static and self-satisfied, it must continue to make for a better place to live.

The two most important things in the world—one of them is the saving of souls as the evangelists say—the second is the power business (energy). If you have abundant energy, you can do anything within reason. And in TVA, you have an opportunity to be a part of the energy picture producing electricity cleanly and at a cost that people can afford. □

Roosevelt had asked for "50,000 planes in quick order." The planes would demand aluminum, the aluminum would require electricity, and that electricity would come from dams like Douglas, which was completed in only 13 months, and Fontana pictured here, which was completed in only 23 months.

"When the first electric light bulb came on in a rural home, it was just like going to church."
--G. O. Wessenauer

G. O. Wessenauer was manager of Power for more than 25 years--years when the TVA system grew from two million kilowatts of mostly hydro capacity to a predominantly coal-fired system at 18 million kilowatts.

Graduated from the Carnegie Institute of Technology (now Carnegie-Mellon University) in 1927 with a degree in Civil Engineering, he worked for both the West Virginia Power and Transmission Company and the West Penn Electric Company before joining TVA as a hydraulic engineer in 1935.

His rise at TVA was rapid. Wessenauer was named power supply engineer in 1938, assistant to the manager of Power in 1941, assistant manager of Power in 1942, acting manager of Power in 1943, and manager of Power in 1944. He was in the cat-bird seat during the building of the Douglas Dam, the machinations of the Dixon-Yates Controversy, the construction of TVA's first coal-fired plant through the start of construction of the largest Cumberland Steam Plant, and the commitment to build five nuclear units. During his tenure, revenue bond financing for the power program was authorized and established.

Since his retirement from TVA in 1970, Wessenauer has maintained his contact with the power industry, working as a consultant with TVA and other power systems advising on management and operating matters including nuclear facilities, nuclear fuel, fossil fuel supply, power rates, and environmental considerations.

TVA was born in controversy after a decade of debate concerning the disposition of Wilson Dam and the chemical facilities at Muscle Shoals. It was opposed by fertilizer, railroad, and coal interests, but the major opposition came from the power companies.

However, the need for improving the economy of the region, suffering in the midst of the Great Depression, led to the enlistment of the project in the service of the people.

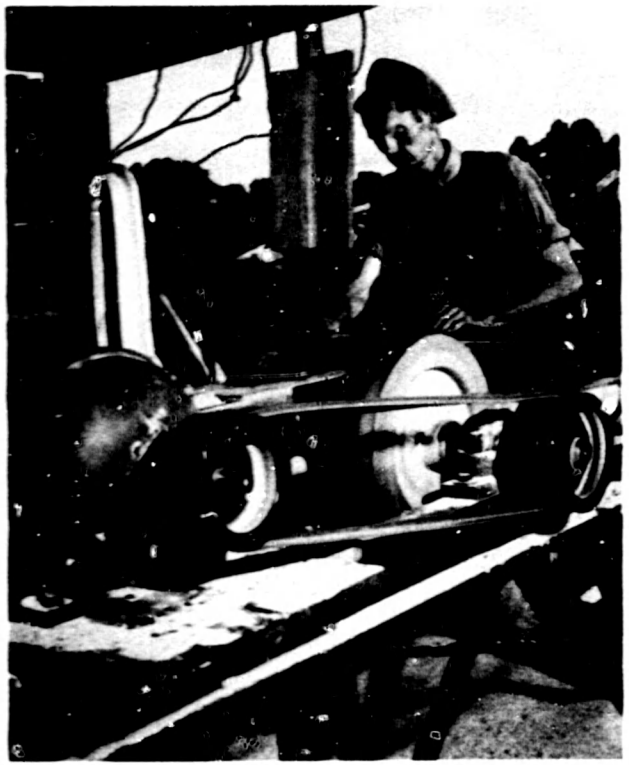
Among its many assignments, TVA was directed to make the power produced at its projects available for the benefit of the people of the region at the lowest possible rates consistent with financial soundness of the power program. What an exciting and challenging assignment that turned out to be, not only to the TVA organization but to countless others throughout the Valley who shared in carrying it out!

"When electricity is put in the hand of the worker, he can do a lot more in a day."

The people of the Valley responded by seeking a supply of TVA power from Wilson Dam. Those communities which owned their own distribution facilities were among the first, and TVA made arrangments to transmit the power over existing transmission facilities of the power companies. Other cities including Chattanooga, Memphis, and Knoxville tried to negotiate the purchase of distribution facilities from the power companies then serving them. Refused, they obtained approval from the electorate (in many cases by overwhelming majorities) to build their own duplicate systems.

The people in the rural areas wanted electricity, too. Only 3 percent of farms had electricity. The power companies maintained that the farmers couldn't afford electricity. The cost of building lines to serve only two or three customers per mile and the small amount of electricity the farmer would use would result in a rate higher than the farmer would pay.

TVA developed a system for building less costly rural lines and proceeded with the conviction that electricity use would not be limited to a single light bulb per room but rather that low rates would encourage use in many



"When electricity is put into the hand of the worker, he can do a lot more in a day," said G. O. Wessenauer and this farmer from Blue Ridge, Georgia, would probably agree.

ways as to make electric service feasible. While TVA financed some of the first lines, soon the Rural Electrification Administration took over financing construction of distribution systems in the rural areas of America.

When the power companies failed to halt the TVA power program through litigation, they agreed to sell the generating and transmission facilities to TVA and the distribution facilities to the municipalities and cooperatives. This advanced the bringing of TVA power to the people they served.

The people were quick in putting the low-cost electricity to work. In rural Mississippi, one of the first appliances purchased was a shiny white washing machine which was put on the front porch. They wanted the passerby to know they had TVA—it was a status symbol.

In encouraging the use of electricity, TVA teamed up with the State Health Department to promote safer water supply and better health. Electric water pumps brought running water into the house, and made possible modern plumbing and septic tanks, reducing the possibility of tainting the well water. Low-cost electricity was used for refrigeration and cooking of food, bringing running water for other farm purposes and in many other ways to make farming easier.

Similarly, its availability in the home, wherever located, lessened the drudgery of household chores and freed the housewife to engage in other activities. The average annual residential use in the Valley in 1933 was about 600 kilowatthours, and in recent years, it has been up to 15,000 kilowatthours.

The use of low-cost electricity in commerce and industry was an important factor in improving the standard of living in the Valley. In 1933 per capita income was 45 percent of the national average when family income depended largely on hard, back-breaking work. When electricity is put in the hand of the worker, he can do a lot more in a day. He can earn higher wages and improve his standard of living.

By 1980 the per capita income in the region had increased to 77 percent of the national average.

Energy use in business and industrial type establishments increased from three billion kilowatthours in 1939 to over 78 billion in 1980. Personal income had grown from $1.4 billion to $58 billion in the same period. There were many requests for TVA power, some from great distances. The TVA Act states that the power is to be distributed within transmission distance primarily for the benefit of the people in the region It was expected that the region would include the drainage basin of the river and the area around Muscle Shoals was among the first to get TVA power. But there were requests from areas outside the drainage basin such as Tupelo, Mississippi. Memphis and Nashville were also outside the basin but within transmission distance. Kingsport and Asheville, within the drainage basin, however, did not actively seek TVA power.

With the acquisitions of 1939 and 1940, a unified power service area became fairly well defined at that time. Within that area, power use was about three billion kilowatthours. The river, when developed, was expected to produce about 15 billion kilowatthours—five times as much. Under normal circumstances, that amount would have provided an adequate supply of power for quite a number of years.

Then the war came along and planes were needed and in turn large amounts of aluminum. Expansion of the aluminum plant at Alcoa and a new plant at Muscle Shoals called for much more power. You may recall Roosevelt had an initial program for 50,000 planes in quick order. "An impossible task," some said. But they got them on time. And there were many more needed before the war ended. TVA supplied the power required by the aluminum plants in the Valley. Large amounts of power were required for producing other materials vital to the national defense such as phosphorous, ferro alloys, and ammonium nitrate. Military establishments—camps and air bases—were demanding power. At Oak Ridge a "hush-hush project" needed a big chunk of power. Up to 75 percent of TVA's power production was going into the war effort.

In order to meet these requirements, TVA expedited the construction of its hydro projects. Douglas Dam was completed in 13 months—a record for a project of that size. TVA also built the 240 megawatt coal-fired plant at Watts Bar in rapid time. This was the first steam plant built by TVA. The system had a number of smaller coal-fired plants which had been acquired in 1939. As a result of building all these projects, power use in the region was able to reach 10 billion kilowatthours in 1945.

But when the war was over, Mr. Lilienthal became concerned as to what TVA would do with all of the power that had been going into the war effort. It was a short-lived concern. A large backlog of requests for service was on hand because the distributors could not get materials to build the necessary lines and other facilities required to serve them. Also electrical appliances of all kinds were unavailable during the war period so a large unfilled demand had been accumulating. In the year following the war, TVA sold less electricity than the previous year but then sales shot up as these unfilled demands were met. So TVA's concern was soon turned from disposing of a surplus to coping with this rapid growth in demand.

"TVA ran out of rabbits to pull out of the hat."

At wars end, TVA was finishing Kentucky Dam, and it became clear that not much more power could be developed from the river. When the service area was established in 1939 to 1949, it seemed that the hydro power would provide for the area's needs for a long time. But it didn't. TVA, with Congressional sanction, had become responsible for the electrical energy supply for the region. TVA thus had an obligation to continue providing for its increasing power needs or the region's economic growth would be curtailed.

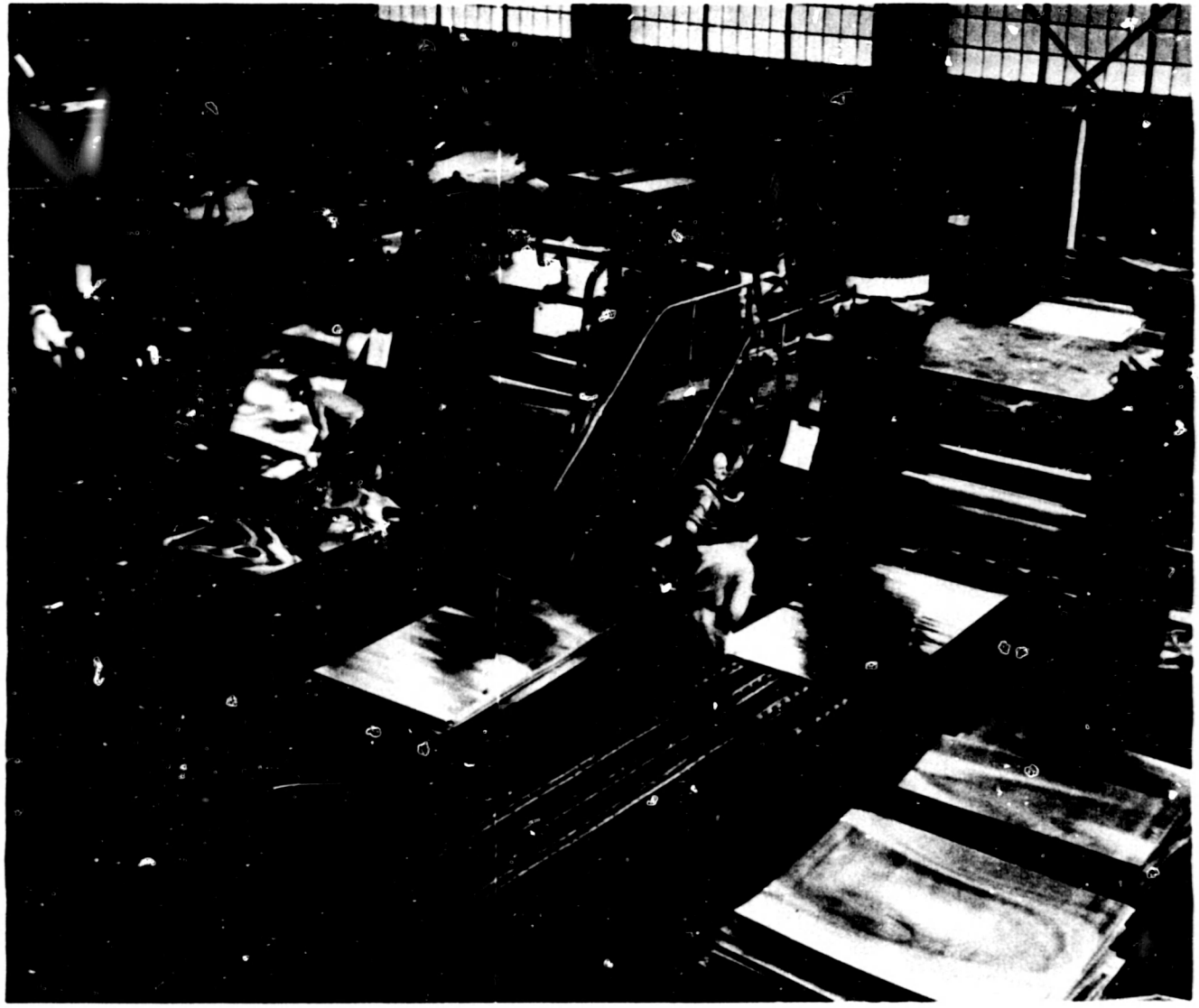
Not only were requirements for normal activities within the region growing but the plants at Oak Ridge enriching uranium for atomic weapons were to be expanded as a result of the conflict in Korea. TVA was called on to provide a very large amount of power for expanded facilities at Oak Ridge and for new facilities at Paducah.

By 1948 annual power use was approaching 15 billion kilowatthours and use over 20 billion kilowatthours was projected for 1952. Early in 1948, TVA recommended the construction of the Johnsonville Steam Plant with three 125 megawatt units. Studies had indicated the cost of energy from the plant would not require an increase in power rates. However, because half the unit energy cost would be for coal and its transportation, it was recognized that rate schedules would have to provide for possible future changes in fuel costs—costs which were not under the direct control of TVA.

Congress did not approve the initial request for appropriations that year, but in the next year, after considerable debate, they were approved. This was a very important milestone decision since it gave further assurance that TVA would continue to meet its obligation to provide power for the region's economic growth.

Johnsonville was followed by Widows Creek, Kingston, Shawnee, Colbert, John Sevier, Gallatin, Paradise, and Bull Run. In the building of these plants, TVA continued to be guided by the directive that power was to be provided at the lowest possible cost. Each recommendation took advantage of the latest developments in the industry. TVA was in the vanguard in using larger and larger units from 125 megawatt units at Johnsonville to a 1,150 megawatt unit at Paradise since the larger units made possible a lower price per kilowatthour. Technological improvements in the thermal cycle resulted in using less fuel to produce a kilowatthour.

In the fall of 1953, another serious matter arose in connection with the region's power supply. TVA had requested appropriations for the building of a steam plant at Fulton, Tennessee. The President refused the request and the Atomic Energy Commission was directed to reduce TVA's projected supply to its Paducah plant and seek another supplier. Dixon-Yates responded and contracted to supply the power from a steam plant to be built in West Memphis, Arkansas. The AEC then sought a contract with TVA for transmitting the power over its system to AEC's plant at Paducah. This TVA was



Aluminum rolled from plants like these to support America's prodigious war effort

reluctant to do. To TVA and the distributors, this proposal seemed to be an opening wedge whereby the region would be forced to obtain its future power requirements from private companies rather than from TVA.

Opposition to the arrangement developed and vigorous protests were registered with the Congress, and it was subjected to much debate and investigation. Charges of improprieties were made and the matter dragged on. While the outcome was still in doubt, the city of Memphis, concerned about ultimately being forced to rely on Dixon-Yates for a power supply, announced in June 1955 that it would build its own plant and not renew its contract with TVA. The arrangements with Dixon-Yates were cancelled and the AEC turned to TVA for the power it needed.

"Roosevelt had an initial program for 50,000 planes in quick order. 'An impossible task,' some said. But they got them on time."

The Dixon-Yates episode brought into focus the precariousness of relying mainly upon appropriations for funding future power projects by TVA. In April 1955 TVA proposed legislation which would authorize TVA to issue revenue bonds to the public for financing further expansion of its power system. The Bureau of the Budget developed an alternative proposal which would keep TVA under its thumb as to future expansion. Controversy raged over these alternatives for four years, but in August 1959 a bill was signed that was satisfactory to TVA. One feature of the legislation, however, was the establishment of a boundary on TVA's service area. This new authorization is another important milestone in the struggle to assure the region of an adequate power supply at the lowest possible cost.

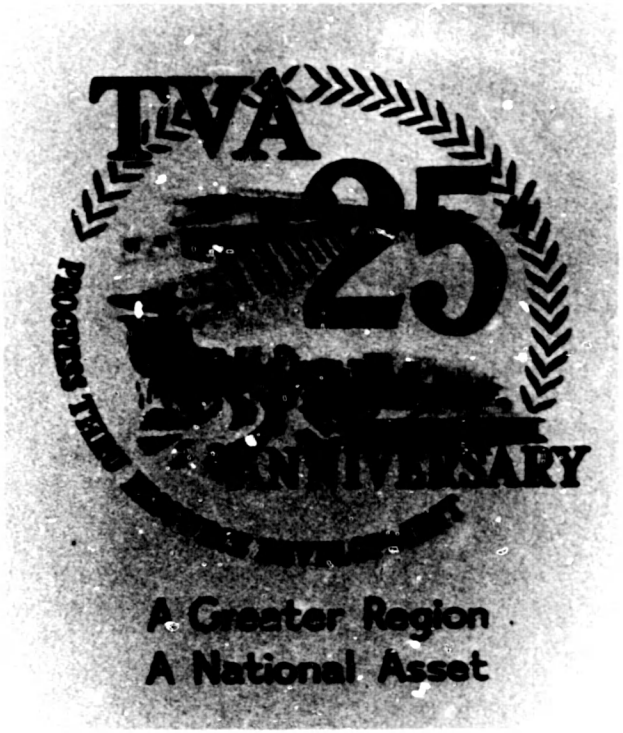
TVA was able to offset the effects of inflation in the 1950s and early 1960s and maintain its wholesale rate schedule. In 1968 the average rate for residential use had decreased to 0.89 cents per kilowatthour. However, by 1964 inflation was making each successive unit more costly than the previous one. So TVA decided that it ought to look for some other way of providing electric energy. TVA had anticipated that nuclear power might be a possibility. Unfortunately, atomic power arrived as a bomb. But in 1946 I served on a committee of industrialists who visited many AEC's installations to learn about possibilities for peaceful uses of nuclear energy. Subsequently, TVA assigned staff to a number of AEC laboratories and eventually agreed to be the operator of an experimental gas-cooled power reactor at Oak Ridge. This provides TVA with a group of knowledgeable people on nuclear power.

TVA undertook a thorough investigation into the possibility of building a nuclear power plant. The economic studies showed that when compared to a new coal-fired plant, the nuclear plant would provide energy at the lowest cost. Consequently, Browns Ferry was selected. Shortly thereafter, because of a short time schedule for supplying more power, the coal-fired alternative—Cumberland with two 1,300 megawatt units—was undertaken. So TVA built them simultaneously. And the original conclusion of the studies was verified—Browns Ferry is producing energy at a lower cost than Cumberland. Again utilizing nuclear power was in line with making power available at the lowest possible price for the benefit of the people.

Well, TVA ran out of rabbits to pull out of the hat. Inflation was accelerating. OPEC pushed up the price of oil and other energy sources, like coal and uranium, followed along. The cost of money also was rising. Stricter environmental standards required more costly facilities which use energy instead of producing energy. Consequently, the rates for electric energy in the region had to go up if costs were to be covered.

Who likes prices going up? When prices go up at the grocery store, you grumble about it, but you pay it. You try another store and find you cannot do any better. One might say TVA, being a monopoly, charges what it pleases. But that is not so. It is explicitly required by law to provide energy at the lowest possible cost. At TVA they work their tails off to try to keep energy prices down. People just don't understand the factors outside TVA's control make prices go up or that TVA has no stockholders to share with the consumers the consequences of changes in costs of providing the energy.

Yes, the assignment was a challenging one, and I believe the accomplishments over the past 50 years far exceed the expectations of those who envisioned it.



These accomplishments were achieved by the cooperative effort of the loyal, able, and dedicated men and women in the TVA along with countless others with similar motivation throughout the region and in many other parts of our great country. It could not have happened without the understanding and support of the people of the region.

The program is an ongoing one. Availability or an adequate suppy of energy continues to be essential to our welfare. Future circumstances will bring changes which may affect its cost and how it is produced and utilized. The challenges for the future, as in the past, are great. I am confident that with the same spirit and dedicated service and public support, they will be met.

You know, I enjoyed every bit of my work with TVA. It was really great. Great to go to work every day. There were many thrilling experiences, such as when the first electric light bulb came on in a rural home. It was just like going to church and being inspired to help others. □

"Our loyalty and interest in TVA and what TVA is trying to do didn't just turn off when we retired from TVA."

--Godwin Williams

Godwin Williams graduated with a B.S. degree in Electrical Engineering in 1936 and began work with the Tennessee Electric Power Company (TEPCO) in its middle Tennessee district. He transferred to Chattanooga in 1937 as power system dispatcher, and when TVA acquired TEPCO August 16, 1939, he was retained by TVA. He worked as power system dispatcher until 1945 when he became an electrical engineer in the Power System Operations Branch. In 1953 he became assistant to the director of Power System Operations, in 1960 assistant director of Power System Operations, in 1968 director of Power Operations, in 1971 assistant manager of Power, and in 1977 manager of Power.

He retired in January 1978 as manager of Power. He has kept close ties with TVA serving as president of the Chattanooga Chapter of the TVA Retirees Association in 1981 and as Valley-wide president in 1982 and 1983.

In 38 years of working with TVA, there were many, many jobs I had to undertake which were, I considered, very difficult at the time. The thing about working with an organization like TVA is that the job might be difficult, but by the time you get into it and begin to find solutions and get the job done, it doesn't seem difficult anymore. It's so exciting it's not difficult.

There were occasions when—because of generating capacity shortages, because units would be off or generating plant construction schedules would be delayed—the power system had insufficient generating capacity to carry the loads at peak times.

At one time in the 1970s, there was a coal miners' strike that severely curtailed the supply of coal to TVA. TVA relied upon coal for a great deal of the energy that it generated and sold to its consumers, so we had to impress upon our consumers the importance of cutting down on their electricity use at peak time. It was hard to make them understand this. It goes against the grain of a power man, you know, to say, "Don't use electricity," when you've spent your life devoted to supplying it, having it there anytime anybody wants it.

When I became manager of Power, we were in the process of developing a revised wholesale rate schedule with the distributors. One of the features of this revision was to encourage distributors to provide their own high-voltage power facilities. Traditionally, distributors had accepted delivery of power from TVA at low voltage, like 12,000 volts. And they received it on their distribution lines at TVA substations and distributed it to their customers. As power distribution systems grew, the economics dictated that they should have more of the high-voltage components in their systems.

The distributors were divided over this issue. There were some who recognized that it would be to their advantage and to the advantage of their consumers if they were to enter into this kind of contract. There was another group of distributors who felt that they were being unduly penalized. This period of having to negotiate with these distributors, who were responsible people with the same motives that TVA has, was very painful to me. After all, we're partners, TVA and the distributors are partners in providing the lowest cost electric power to the consumer. The outcome was that the rate schedule was placed into effect. And to the best of my knowledge, even the distributors who objected to it are much bettter off because of it.

In the early years of World War II, TVA was very important to the war effort. There were large aluminum production plants at Alcoa, and aluminum was badly needed to produce aircraft. Even before the U.S. got into the war, it was trying to provide increased supplies of aluminum to produce aircraft for Britain and France. So TVA went all over this whole region to find any possible source of electric energy that could be tied in with the TVA system, so that we could absorb the energy at any hour of the day or night and deliver it to the aluminum company to produce aluminum. This required manipulating the TVA power system almost hourly, sometimes more frequently than hourly, all through the day and the night.

The dispatchers did this. We had to continually watch the balance of power resources and power loads in different parts of the system. It involved continually rearranging portions of the system to maintain the balance of load and generation and power supply that you wanted so as to completely use all the capacity of each interconnection. And this was like a Chinese puzzle, all day and all night. It took your complete attention and whatever initiative you could drag up to get the best possible results. That was a very satisfying period of my TVA career.

"I don't know who would have been able to forecast the economic recession we now have when these power plants had to be started."

While I was assistant manager of Power, we had gone through a series of rate increases. The first started in 1967, and they had come pretty regularly after that. Customers couldn't understand it. I'll never forget going to Board meetings in Knoxville with protestors sitting out in the audience with big placards and booing, hissing, and complaining to the Board. There was a lady from east Tennessee who lead a delegation of protestors, and she got up in front of the microphone and said all her people up there were poor folks and that they were cold and that power was costing them more than they had and something should be done. She was demanding the Board come up there and talk to her people. I told her, "If you really want to help, let us send some people up there who are experts, who can examine the houses of people who are having these problems and see what needs to be done that might help."

We did this, and it worked out that we were able to show these folks how to conserve energy in this little community. This experience stuck with me, and it stuck with Red Wagner, too, because when I became manager of Power, one of the first things he started pushing me about was, "Why can't we have some sort of program to help people insulate their homes?" And I said, "Well, I don't know why, but we'll see."

The Power staff got busy, and we developed and presented to the Board what is now the Home Insulation Program.

TVA's had so many fine hours and will no doubt have many, many more. It's always seemed to be able to respond and respond quickly to what the needs of this region happen to be.

The media have characterized the load estimates of the 1960s and 1970s as errors, misjudgment, and poor management. That's crazy. Not only has the construction of nuclear plants and any other power plants slowed down to practically zero in the TVA region, they've slowed down all over the United States and all over the world because there is a big economic recession. Regardless of all the other influences—things that influence power use like conservation and some of these other things, the main cause for it, in my opinion, is the economic recession.

With an economic recession, if the demand for the products of industry decreases so that industry doesn't need to produce its products, the plants are shut down. These plants consume power when they're running, and when they're not running, they don't consume power. I don't know who would have been able to forecast the economic recession we now have when these power plants had to be started. With all of the indicators that were available at the time, the output of the plants was going to be required if this region continued to grow like it should grow and like it had the capability to grow. It couldn't do it without the required supply of energy. You had to build plants.

The economic recession came, and the loads didn't develop. The load growth slowed down, so all the anticipated plants weren't needed. It's not only true of power plants, it's true of plants that produce rubber tires, automobiles, or anything else the demand for which has decreased due to the economic recession. It's pretty obvious.

Fifty years of TVA history mean that a number of people have completed their careers and retired from TVA. There are over 8,000 retired TVA employees or their beneficiaries. They are scattered all over the world. But a large number of these retired TVA employees live in the TVA region. And we watch TVA very closely. Our loyalty and interest in TVA and what TVA is trying to do didn't just turn off when we retired from TVA. We carried it with us. And we still have it. □

An electric motor to enable the demonstration of an electric milking machine and the promise of assistance in wiring were the powerful incentives used by TVA's Electrical Development Division to encourage rural electrification.