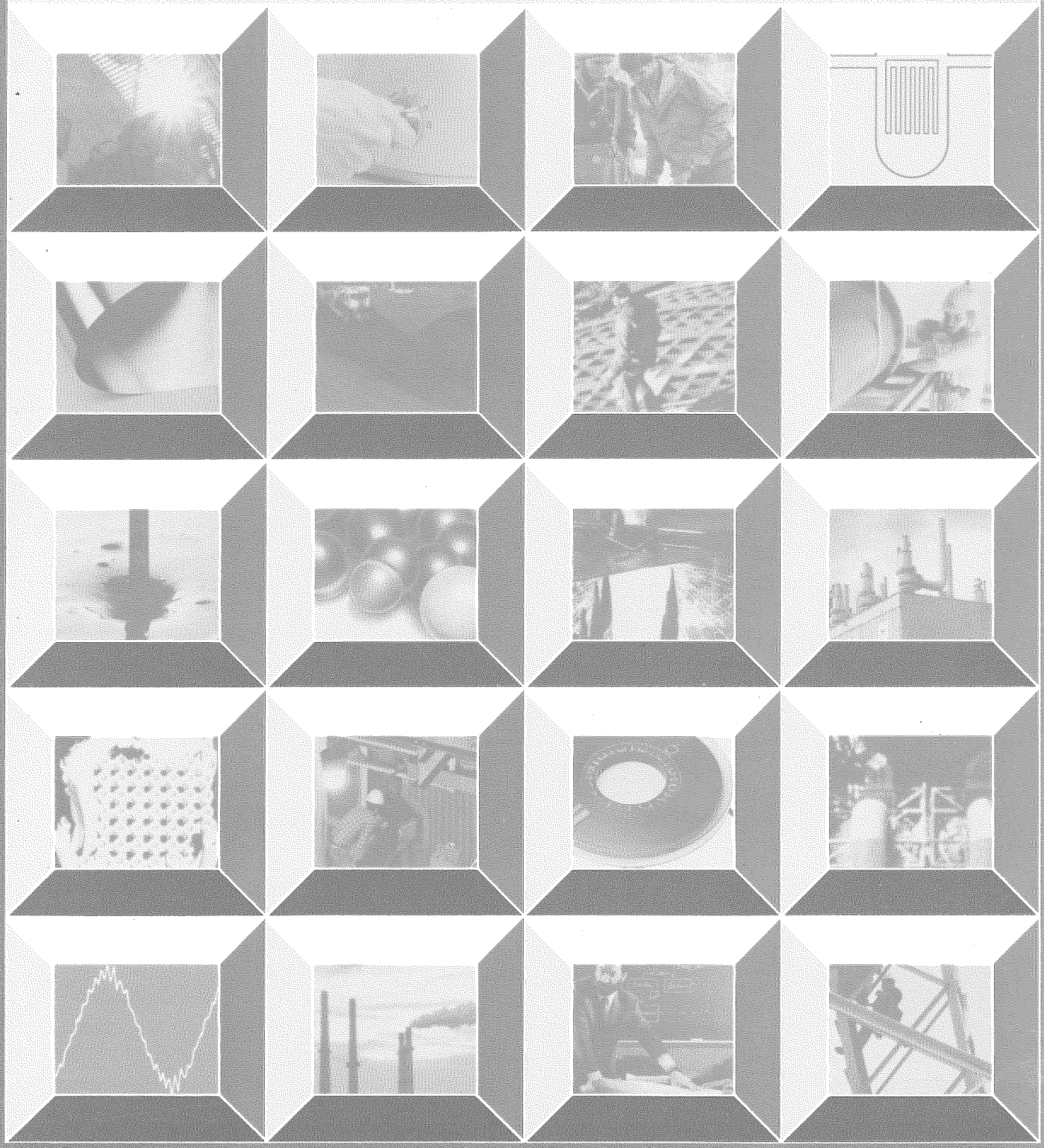
1984 ANNUAL REPORT ELECTRIC POWER RESEARCH INSTITUTE

Responding to Utility Research Needs



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STATEMENT OF BUSINESS

The Electric Power Research Institute (EPRI) plans and manages research and development on behalf of the nation's electric utility industry and the public. The Institute's objective is to advance capabilities in electric power generation, delivery, and use, with special regard for safety, efficiency, reliability, economy, and environmental considerations.

Founded as a nonprofit corporation in 1972, the Institute is supported on a voluntary basis by 473 members, including investor-owned companies, municipal and regional government utilities, and rural electric cooperatives. These members deliver about 70% of the nation's electric power, and their 1984 payments to EPRI, based on business volume, totaled $303 million.

Nationwide in scope, EPRI's research proceeds on a scale no single utility could undertake alone, and the results become a pool for the benefit of all members and the customers they serve. The regulatory environment in which utilities operate ensures that the economic benefits of R&D ultimately flow through to the ratepayer.

Two special advisory groups complement EPRI's Board of Directors in furnishing policy and program guidance. The Research Advisory Committee, made up of utility executives, provides technical counsel on EPRI's programs and progress. The Advisory Council, drawn from the spheres of education, business, government, science, and other groups outside the utility industry, advises EPRI's Board and president on the emphasis and direction the Institute's research program should take in meeting the broad needs of society. ■

CHAIRMAN'S MESSAGE

Unlike the chairman's message in most annual reports, this one is not about what EPRI accomplished in 1984 but rather about the challenge we in the industry face for the balance of this century. As one discusses the future of the electric utility industry with its leaders, a sense of uncertainty and disorder dominates the conversation. This lack of clarity in the industry's vision of its own future was manifest in the results of the review of EPRI's effectiveness that was completed last year.

In 1984 the Board established an Effectiveness Review Task Force, chaired by Board member Frank Griffith of Iowa Public Service Co. The task force found strong industry support for EPRI and its activities and identified a number of areas in which the Institute's effectiveness could be improved. The Board will be authorizing modifications of EPRI practices in response to those opportunities.

The most important challenge in the review, however, is directed to the members of EPRI. That challenge is to bring about a quantitative increase in our commitment to R&D. A survey of utility management opinion, conducted as part of the review, revealed strong support at all levels for a major increase in R&D funding. This need is also recognized by the members of state regulatory bodies who sit on EPRI's Advisory Council; in fact, they have offered to communicate the need for support to others in the regulatory community.

The Board was startled by the broad support for greater emphasis on R&D. I have reflected on the survey results, trying to ascertain the reasons for what I perceive to have been a major shift in attitude during my relatively short tenure on the Board. I know my own personal uncertainty concerning the future has strengthened my commitment to R&D. In periods of uncertainty and disorder, I believe all of us want flexibility—more options and more time to make decisions. The many objectives of EPRI's programs are, in

large measure, designed to meet this need. To me, therefore, both the effectiveness review and the opinion survey reveal a strong industry consensus acknowledging EPRI's contributions to date and supporting an even greater role in the future.

The difficult task now is for the Board to translate this consensus into specific programs that will merit strong industry support for increased dues. I am confident the Board will rise to this important challenge.

The Board is deeply grateful to Frank Griffith for his thoughtful and able chairmanship of the five-member task force and also for the quality of the report. The report gave EPRI high marks for success in fulfilling its mission and establishing a reputation for excellence in R&D. The report also recommends further emphasis on translating research results into industry practice. This challenge of effective technology transfer is another major issue that the Board will confront in 1985.

This annual report details a very active and successful year for EPRI. Only those of us who have had the privilege of serving on the Board or the industry advisory committees can fully appreciate the quality and commitment of EPRI's staff. Certainly, the results of the effectiveness review confirm my own judgment that the industry can be very proud of what EPRI is achieving.

It has been a privilege for me to serve as EPRI's chairman for two years, and I am grateful for having had the opportunity to do so.

A. J. Pfister
Chairman

PRESIDENT'S MESSAGE

The past year has been perhaps EPRI's best in terms of overall achievement. Most noteworthy was the completion of the advanced coal gasification–combined-cycle demonstration plant that is a prototype for clean coal combustion in the future. We also received a gratifyingly favorable effectiveness review from the EPRI Board of Directors, which is discussed in the Chairman's message.

Several programs that were considered long term when EPRI was established produced outstanding results in 1984. The atmospheric fluidized bed, for example, has operated well and has provided data for a commitment to three industrial-scale demonstration plants. Two new industrial batteries operated successfully under utility conditions, and commercial versions are being offered. We have also been part of the effort that produced a successful prototype fuel cell for utility systems.

In other areas the knowledge produced by EPRI research on corrosion and cracking in nuclear reactors was sufficient to avert an early shutdown of eight nuclear reactors for inspections. We completed a program that proves the reliability of nuclear fuel for about 30% higher burnup. And on the laboratory level we produced a photovoltaic cell that uses sunlight efficiently enough (20% now, maybe 25% later) to produce electricity at competitive costs.

Many of the new products and systems emerging from EPRI research will help improve the reliability and productivity of existing utility investments. Improvements in coal-cleaning methods that can save millions of dollars a year at some major coal-burning plants, for example, are coming from the Coal Cleaning Test Facility in Pennsylvania. A slit metal sleeve has been developed that makes it possible to repair wooden utility power poles in place for an estimated saving of about $850 per pole. And the Clor-N-Oil field test kit for analyzing PCB contamination in transformer oils is now being used in quantities of about 20,000 a month, at a saving of $40–$50 per sample.

In the environmental area EPRI research is contributing both to the basic understanding of important problems and to the search for possible solutions. In the area of acid rain, for example, a computer-based simulation model—the integrated

lake-watershed acidification study (ILWAS)—makes it possible to predict the effects of acid deposition on the acidity of lakes where soil characteristics are known. Results gained from this model suggest that a sensible strategy for abatement of acidic effluents from existing coal plants is to employ measures short of scrubbing, such as coal washing, coal switching and blending, NO_x control with low-NO_x burners, and perhaps liming of heavily impacted lakes (as is practiced in Sweden).

For new coal-fired plants, more-advanced approaches to effluent control are now becoming available. The best example of new, clean-burning coal technology is the 100-MW coal gasification–combined-cycle plant now operating in its early test program on the Southern California Edison Co. system at Cool Water, California. The plant has already met or exceeded all design specifications, as well as all federal and state standards for sulfur oxides, nitrogen oxides, and particulate emissions. In addition, fluidized-bed systems, fuel cells, and other new technologies will provide utilities with superior options for burning coal cleanly.

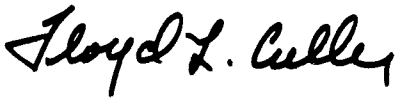
As always, new problems are emerging that will also demand increased attention in our research programs. In EPRI's environmental program, for example, greater emphasis must be placed on dealing with hazardous materials in solid and liquid wastes. Almost every element of our demand-side program will also require additional effort. The scope of this work covers demand estimation and end-use planning, demand management, and most important, development of new processes that use the unique features of electricity.

I discussed this electricity program last year by describing the early phase of our work on increasing the productivity and decreasing the costs of electricity use. This year we started two collective development centers in cooperation with key electricity-consuming industries. The first, at Battelle, Columbus Laboratories, is coordinating development work in metal fabrication with support from about 30 companies. The second center, at Carnegie-Mellon University, is working on metal reduction processes and has more than a dozen corporate sponsors.

The electric power industry is perhaps in the period of greatest change since its founding, and EPRI's R&D programs should be directed toward helping utilities adjust to these changes as efficiently as possible. Concern for environmental and health protection will continue for the long term, with increasing attention given to toxic materials in solid and liquid wastes. By 1990–1992 additional generating capacity will be required, and we must marshal advanced technologies to meet those requirements.

At the same time we must continue to exercise every reasonable approach to keep the cost of power to consumers low by performing research aimed at reducing new capital investments, obtaining more efficiency and greater longevity from existing plants, and utilizing cogeneration and sources of "opportunity power," such as wind and solar energy. Recognizing, however, that coal and nuclear power will remain the primary energy sources for utilities, EPRI must continue demonstration projects of major coal technologies and initiate a broad-scale approach to improve the design of light water reactors.

For the products of R&D to become widely used throughout the utility industry, technology transfer efforts must also be accelerated. Within EPRI we are concentrating more resources on making our knowledge available to individual utilities, but it is clear that we must have the help of our members in this absolutely necessary effort. I suggest that you may find it beneficial to establish a system within your company to review and assess each of EPRI's products and programs to determine if and how they can be useful to you and how we might work with you in making them effective. Accelerated efforts by all parties will be necessary to fully capitalize on the investment our members have made in research and development.



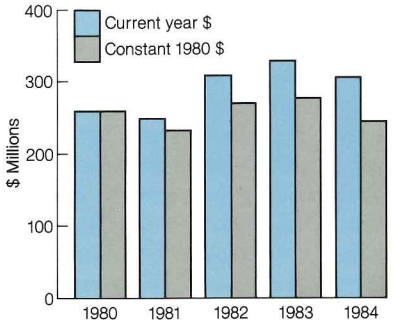
Floyd L. Culler
President

Highlights of 1984

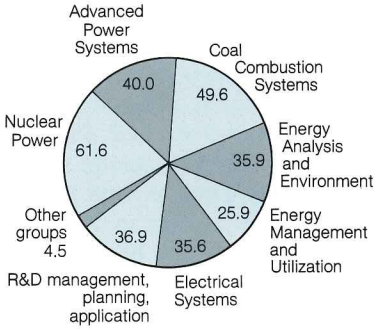
1984 Expenditures Drop From 1983, Recovery Planned

Totaling $308 million, EPRI's 1984 expenditures were about 6% below the previous year-end figure of $327 million and some 10% less than budgeted in January, primarily because of delays in research worth about $14.1 million and construction economies on the Cool Water demonstration project. R&D expenditures were $290 million; technical and industry information, $6 million; and general and administrative, $12 million.

EPRI Expenditures 1980–1984
(Base program R&D and management)



1984 Base Program R&D Expenditures
($ millions)



Revenues grew to $309 million for the year, up 5% from $293 million in 1983. The major gain was in membership payments, which totaled $303 million (up $18 million), while interest and other income fell to $6 million (down $2 million).

The Institute estimates 1985 expenditures and revenues to be about $331 million and $321 million, respectively. It is expected that the $14.1 million R&D underrun will be carried forward into 1985 expenditures. The difference between revenues and expenses is resolved by the timing of actual receipts and payments. □

Year-Long Study Examines Goals, Practices, Results

The year 1984 was marked by scrutiny of several aspects of EPRI operations. Most sweeping was a review of the Institute's effectiveness commissioned by the Board of Directors in December 1983. Directed by a five-member Board task force, study teams sought comment from all of EPRI's industry and other advisers, plus representatives of government laboratories and research agencies, utility industry suppliers, universities, and legislative and regulatory bodies. In addition, the task force sponsored an independent opinion survey directed to more than 400 utility chief executives, including all who head EPRI member organizations.

In a December 1984 report, overall praise of EPRI's work and reputation was accompanied by strong calls for more industry R&D funding and greater effort to put R&D results in use. The Board task force recommended renewed attention to exploratory and long-range research, technologies for more-productive electricity use, and provisions for pilot and demonstration plants. Other findings indicated specific opportunities for improvement in communications, program adjustment processes, and contracting practices. □

Consultant Reviews EPRI Administrative Operations

A summer-long study by Arthur D. Little, Inc., yielded generally positive findings on such matters as EPRI's budget controls, allocation of personnel, program planning and approvals, contractor selection, use of consultants, and appeal to innovative R&D professionals. Under the direction of Senior Vice President David Saxe, EPRI is following up the major ADL recommendations with efforts to improve research project approval procedures, employee motivation, and technology transfer. □

EPRI Officers Focus on Success Factors

Aided by consultants from Index Systems, Inc., Floyd Culler, EPRI president, and Richard Balzhiser, Milton Klein, Richard Rudman, and David Saxe, EPRI vice presidents, reviewed the Institute's goals during October and November, identifying several factors critical to management success and assigning

responsibility for giving them renewed attention. An example noted by Saxe is the need to cultivate openness to the ideas of others and to encourage innovation in both the management and the conduct of R&D. □

EPRI Contracting Studied by Regulators' Association

After reviewing EPRI's R&D contractor selection and award practices, a special committee of the National Association of Regulatory Utility Commissioners reported favorably on the Institute's criteria and procedures but recommended that more of EPRI's work become competitively available to a larger population of potential bidders. NARUC's formation of a standing review committee, consisting of the seven state utility commissioners who serve on EPRI's Advisory Council, was an outgrowth of the study. □

Four New Faces on EPRI Board

Four new Board members were named during 1984, and three directors were reelected. Theodore Carlson of Central Hudson Gas & Electric Corp. and John Ellis of Puget Sound Power & Light Co. were elected at the annual membership meeting in April; on the same occasion Frank Griffith of Iowa Public Service Co., Don Jordan of Houston Lighting & Power Co., and Paul Ziemer of Wisconsin Public Service Corp. were reelected. William Gould of Southern California Edison Co. and John Selby of Consumers Power Co. left the Board.

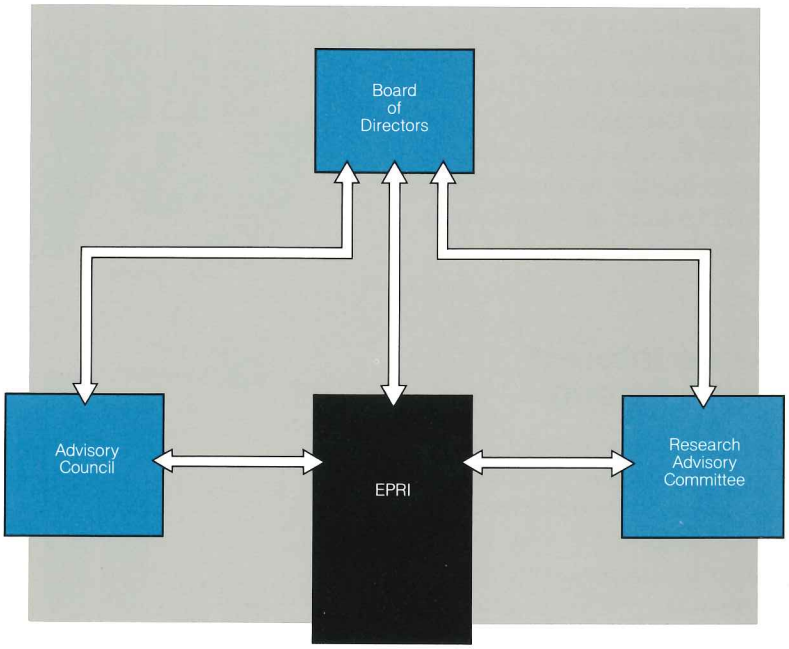
In August John Hudiburg of Florida Power & Light Co. and Sherwood Smith of Carolina Power & Light Co. accepted interim appointments to replace Charles Dougherty of Union Electric Co. and William Reed of The Southern Co. A. J. Pfister of the Salt River Project and Arthur Hauspurg of Consolidated Edison Co. of New York, Inc., continued as Board chairman and vice chairman, respectively, throughout 1984. □

New Members for Research Advisory Committee

EPRI's senior utility advisory group ended the year with 28 members, one more than a year earlier. New RAC members who head division advisory committees are Cameron Daley of Boston Edison Co. (Electrical Systems), Walter Schultheis of Northeast Utilities Service Co. (Energy Management and Utilization), and C. O. Woody of Florida Power & Light Co. (Nuclear Power).

Six other new RAC members are Donald Felsinger of San Diego Gas & Electric Co., James Forest of Northern States Power Co., John Kaslow of the New England Electric System, Robert Marchetti of Minnesota Power & Light Co., Michael Spence of Texas Utilities Generating Co., and John Zink of Central & South West Services, Inc. □

EPRI Management and its Advisers



Advisory Council Fills Vacancies

Six departures were more than balanced by eight new appointments, and EPRI's Advisory Council thus numbered 24 members at year-end, plus the chairman of the Board, who serves ex officio. Appointees to this advisory body, which counsels EPRI's Board and management on matters of public perceptions and needs, are drawn from outside the power industry.

Named to four-year terms were Stephen Brobeck, executive director of the Consumer Federation of America; David Allan Bromley, director of the Wright Nuclear Structure Laboratory at Yale University; Robert Charpie, president of Cabot Corp.; Brian MacMahon, chairman of epidemiology at the Harvard University School of Public Health; Laurence Moss of Energy Design and Analysis, Inc., a Colorado consulting firm; and Herbert Woodson, director of the Center for Energy Studies at the University of Texas.

Two members of the Council, nominated by the National Association of Regulatory Utility Commissioners, are George Barbour of the New Jersey Board of Public Utilities and Robert Bratton of the Washington (state) Utilities and Transportation Commission. □

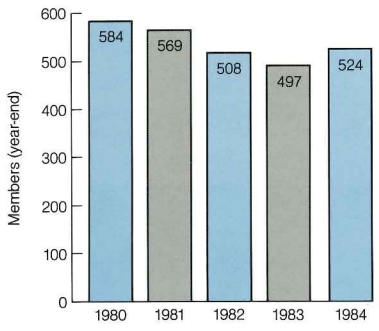
Software Interest Remains Strong

Thirty-one new computer codes were made available through the Electric Power Software Center during 1984, bringing the total to 126. More than 1700 copies were distributed, with nearly 90% going to EPRI members. □

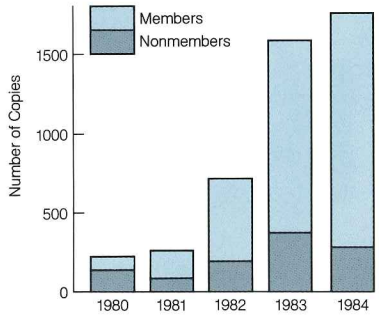
Increase in EPRI Membership

EPRI's roster of members and their affiliate companies totaled 524 in December 1984, well up from 497 in 1983. Most of the gain is traceable to the new memberships of two large generating and transmitting cooperatives and their related distribution utilities. The new total thus includes 209 rural cooperatives, 143 municipal power agencies, 170 investor-owned companies, the Bonneville Power Administration, and the Tennessee Valley Authority. The Institute's membership community delivers about 70% of all U.S. electricity. □

EPRI Membership 1980–1984
(including affiliates)



Software Package Distribution 1980–1984
(individual copies)



Site Chosen for High-Sulfur Test Center

The Somerset generating station of New York State Electric & Gas Corp. has been chosen as the site for EPRI's advanced high-sulfur test center. A design contract for the facility was awarded to Gilbert/Commonwealth, Inc., of Michigan in June 1984. After construction is completed in 1986, a 10-year, $26 million research program will be conducted to improve flue gas desulfurization technology for high-sulfur eastern coal. The host utility will contribute $4.3 million in funds and services to construction and research work at the center, and the Empire State Electric Energy Research Corp. will cofund the project for six years at $250,000 annually. □

EPRI Development Wins IR-100 Award

A new form of gas insulation for electrical apparatus, called vapor mist dielectrics, won an IR-100 award from *Research & Development* as part of the magazine's program to recognize the 100 most significant advances in technology each year.

The award was shared with Westinghouse Electric Corp., EPRI's contractor and cosponsor in developing vapor mist dielectrics. The Empire State Electric Energy Re-

search Corp. also funded the project. In the new insulation, mists take the place of liquid or solid dielectrics in utility equipment; they can also be used to suppress hazardous electrostatic charges in such environments as grain elevators. □

International Activities Expand

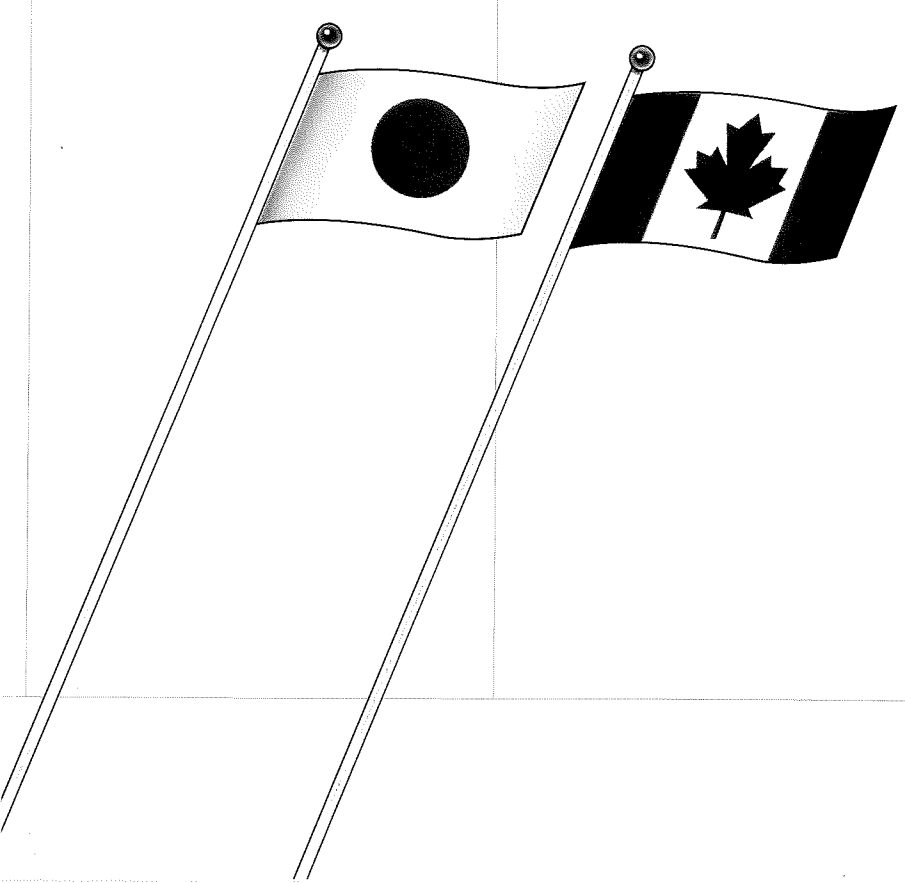
A new international activities office was established in 1984 to coordinate EPRI's growing involvement in international R&D funding, program cooperation, and information exchange. Twenty institutes, government agencies, and utilities of other nations now have broad exchange agreements with EPRI. New in 1984 was Japan's New Energy Development Organization. Also, the Canadian Electrical Association and nine electric utilities and research organizations in Canada became the first international participants in EPRI's Electric Power Database. □

Extra-High Voltage Laboratory Acquired

EPRI has bought the former Phelps Dodge Cable & Wire Co. EHV laboratory in Yonkers, New York. The November purchase was funded by a $2.9 million donation from Consolidated Edison Co. of New York, Inc. Negotiations are under way with a contractor to operate the facility for a proposed five-year, $1.4 million research program of tests on underground transmission cables and other equipment. □

Institute to Handle All Member Accounts Receivable

Following 1984 year-end decisions by the American Public Power Association and the Edison Electric Institute, EPRI made plans for direct receipt in 1986 of quarterly dues payments from individual utilities who are members of those trade associations. Institute dues were first collected by the trade groups in 1973 in connection with EPRI's initial drive for membership, and the practice had continued as a matter of administrative convenience. □



Responding to the Research Needs of the Electric Utility Industry

The 20 research highlights featured on the following pages, selected from more than 1500 projects currently under way, represent the Institute's response to a broad spectrum of utility concerns in the areas of fuels, generation, delivery, energy management, environment, and planning.

Gasification-Combined Cycle

Demonstration of Clean Coal Power

The 100-MW Cool Water gasification–combined-cycle (GCC) demonstration plant came on-line in May, a month ahead of schedule and $31 million (11%) under budget. The GCC technology provides a new alternative for using coal cleanly and economically by first gasifying it and then generating power with a combination of steam and gas turbines. The demonstration plant, now generating power for the Southern California Edison Co. system, was constructed with private funding from an international partnership that included EPRI as the largest contributor. Initial tests at the plant have confirmed its ability to meet the country's strictest emission standards, and it has become the first demonstration project to qualify for price supports from the Synthetic Fuels Corp. Capacity factors for the initial months of operation have also exceeded targets. One of the advantages of GCC is that plants can be assembled modularly, enabling utilities to better meet demand growth. Data from the Cool Water plant will help reduce uncertainties in cost, construction time, efficiency, equipment reliability, system availability, dynamic response, and feedstock flexibility. (RP1459) □

Guidebooks To Demand-Side Planning

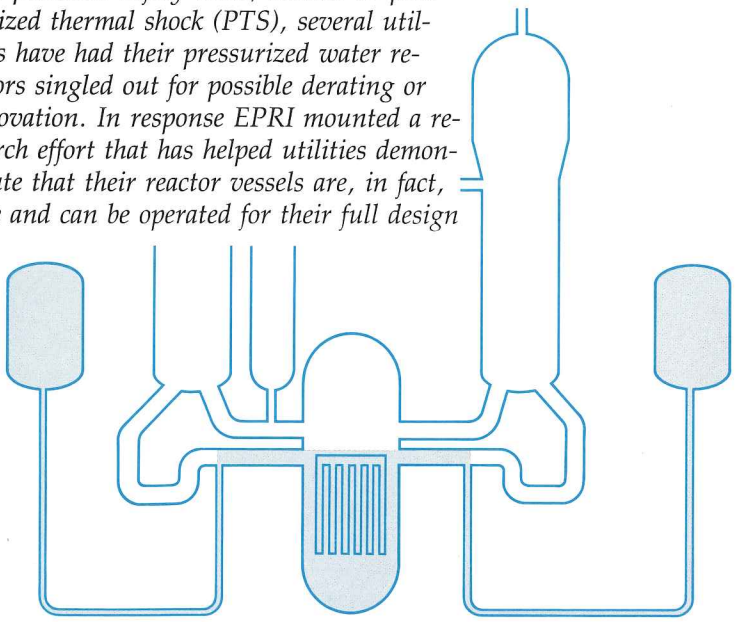
Demand-side planning and management encompasses a wide range of activities that can affect the demand for electricity in ways that are mutually beneficial to consumers and utilities. These include load management techniques, conservation programs, rate incentives, and marketing strategies that can trim, shape, or build utility loads to yield a more efficient use of financial and energy resources. But the specific value to a utility of each approach or combination of efforts depends strongly on local and regional economic and demographic factors and utility resources. A systematic approach to demand-side planning is now available in a series of EPRI guidebooks. The guides cover all aspects of demand-side management, from planning and evaluation to implementation and monitoring. They form a unified framework for assessing the diverse elements of demand-side management. (RP2381-4) □

Modeling the Effects of Acid Rain

Until recently, attempts to estimate the effects of acidic deposition have been largely inconclusive, in part as a result of the lack of detailed scientific understanding of the mechanisms of action and the influence of different local geology, soil, and vegetation. A computer model developed as part of EPRI's extensive studies of acidic deposition simulates the movement of water through a lake watershed and quantifies the processes that can alter watershed acidity. The code, which reflects data and insights gained from five years of detailed sampling and analysis of three lakes in the Adirondack Mountains of New York, can determine the time rate of potential lake watershed change. At least six utilities have already used the integrated lake-watershed acidification study (ILWAS) model to assess the effects of acidic deposition on surface water pH in other specific areas, as well as to guide broader related research on ecosystem effects. (RP1109) □

Analysis of Pressurized Thermal Shock

During the last few years concern was raised over the possibility that introduction of cold emergency cooling water into a hot reactor vessel during a transient might cause enlargement of existing cracks where the vessel has been embrittled by years of service. Because of this potential safety issue, known as pressurized thermal shock (PTS), several utilities have had their pressurized water reactors singled out for possible derating or renovation. In response EPRI mounted a research effort that has helped utilities demonstrate that their reactor vessels are, in fact, safe and can be operated for their full design



lifetime. From this research has emerged an integrated set of computer codes and analytic methods that can be used together with information from a new reactor surveillance data base to predict accurately the ability of a specific reactor vessel to withstand PTS. Five utilities have so far used these techniques to demonstrate reactor vessel integrity, with a potential saving of millions of dollars at each plant. (RP964, RP1550, RP2420) □

Reducing Transformer Losses

Because of their random atomic order, amorphous metals respond more quickly to changing magnetic fields and create only about one-quarter of the power losses in transformer cores as does conventional silicon steel. But amorphous metals have unique mechanical properties, and they present fabrication problems, especially for making transformer cores. As a result, special means have been developed to cut amorphous metal sheets to make stacked cores for power transformers and to wind the strip for distribution transformer cores. These special techniques were used to construct a 500-kVA power transformer with a stacked core that will be delivered to Empire State Electric Energy Research Corp., a co-funder of the project, for use on the Niagara Mohawk Power Corp. system. In addition, 25 distribution transformers with cores wound from amorphous steel are now installed on various utility systems; these will be followed by production of 1000 additional units in late 1985 and early 1986. (RP1290, RP1592, RP2236) □

Coal Cleaning

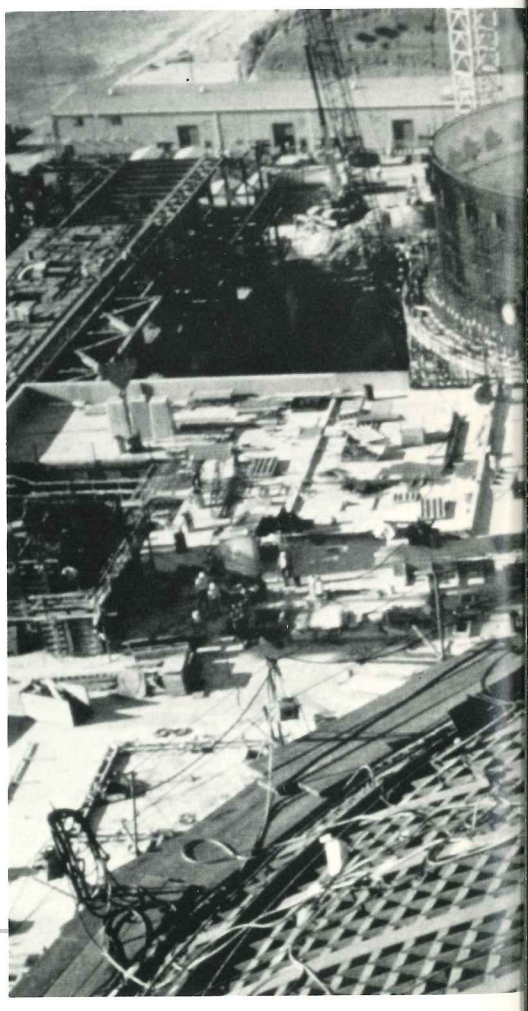
Expanding the Coal-Cleaning Data Base

The Coal Cleaning Test Facility (CCTF) in Homer City, Pennsylvania, continued to advance the state of the art in 1984, characterizing the cleanability of eight coals for seven utilities. Coal analyses allow utilities to design better cleaning plants, operate existing plants more efficiently, and make sound technical decisions about coal quality and combustion. Test results become part of an expanding data base that can be used to improve the performance and environmental compliance of coal-fired power plants. Two utilities cofunding CCTF with EPRI—Pennsylvania Electric Co. and New York State Electric & Gas Corp.—estimate a saving of $68.7 million in revenue requirements over the next 30 years as a result of CCTF engineering and test data that are directly applicable to their adjacent full-scale cleaning plant at Homer City. Other EPRI member utilities also used CCTF test data in their own operations during 1984, including Pennsylvania Power & Light Co., Boston Edison Co., Tennessee Valley Authority, and Cleveland Electric Illuminating Co. (RP1400) □

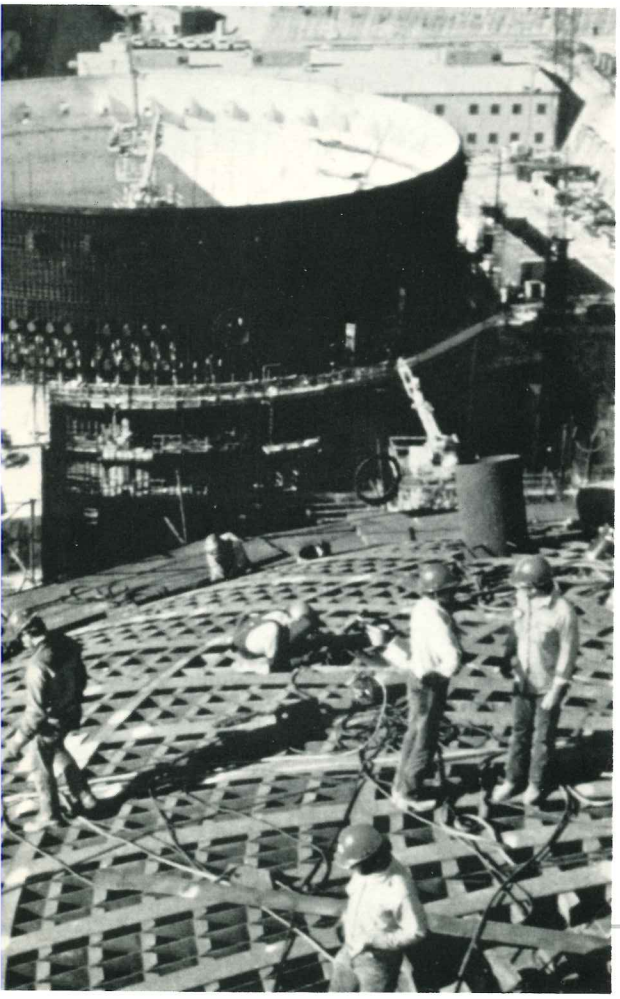
Generation Planning

Improving Expansion Models

Changing economic conditions and a widening choice of technologic options have made generation expansion planning increasingly complex and expensive. Three separate computer programs have traditionally been used in such planning efforts: generation optimization, production costing, and system reliability. All three computation tasks can now be handled by a single, EPRI-developed computer code, using a consistent set of data bases and output reports. The electric generation expansion analysis system (EGEAS) uses new modeling methods that increase calculation

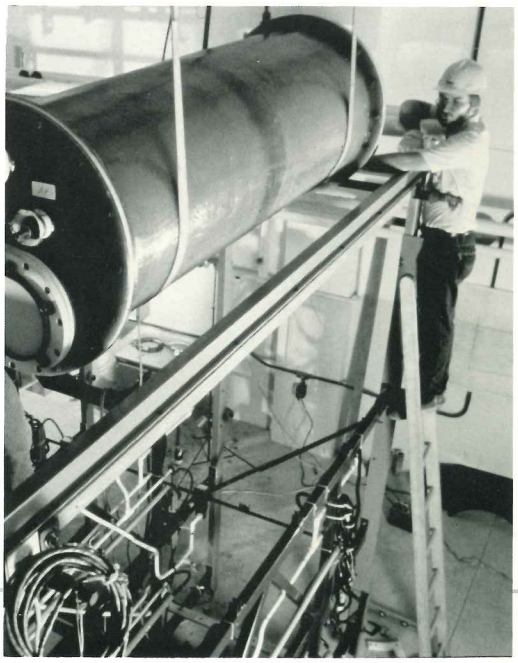


speed by a factor of 10 and provide increased accuracy, compared with previous programs. An active users group has held meetings to share operating experiences, and an EGEAS newsletter helps disseminate information on program enhancements, problems, and revisions. First released in 1983, the EGEAS code has been widely used for such diverse purposes as developing optimal long-range (15–20-year) expansion plans, assessing advanced generation technologies, evaluating power sales between neighboring utilities, and studying the sensitivity of expansion plans to changes in forecasts. (RP1529) □



Advanced Batteries for Energy Storage

The first advanced battery system built expressly for utility load-leveling has been installed in EPRI's Battery Energy Storage Test Facility in New Jersey. Tests sponsored by EPRI and DOE have determined reliability, operating constraints, and maintenance requirements, as well as further R&D needs, of the zinc chloride battery system built by Energy Development Associates, a unit of Gulf + Western Industries, Inc. Ten zinc chloride battery modules delivering 500 kWh operated successfully for over 100 cycles in 1984. Based on the technology tested at the BEST Facility and on improvements made as a result, EDA will begin offering second-generation 2-MW, 6-MWh prototype units to utilities and other potential customers this year. Designed for long life, low materials cost, and short production times, advanced load-leveling batteries will help utilities lessen the need for costly peak generating capacity that requires premium fuels. (RP226, RP255, RP2123) □



Coal-Water Slurry

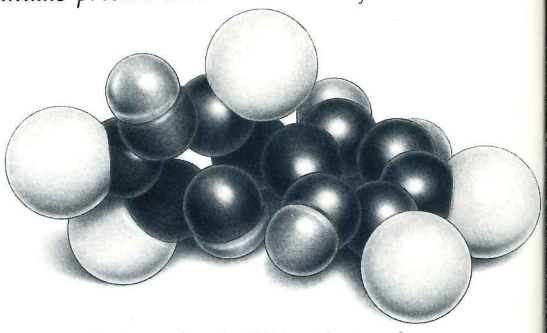
New Burners for a New Fuel

The ability to substitute coal-water slurry for fuel oil in utility and industrial boilers has been confirmed at pilot scale. But the mixture's higher ash content and more-erosive chemistry requires improved burners for large oil-fired utility plants that could potentially convert to coal-water slurry. Such burners have now been developed by Babcock & Wilcox Co. with EPRI support. A test last year involving 500 tons of 70% coal slurry demonstrated stable combustion in a burner with size and performance characteristics comparable to or better than conventional pulverized-coal burners. The burner demonstration—combined with the results of similar tests planned this year by other companies and earlier EPRI studies of coal-slurry fuels—sets the stage for a prolonged, full-scale utility plant demonstration that will confirm coal-water slurry's commercial readiness as a substitute boiler fuel. (RP1895) □

PCB Management

Finding and Disposing of PCBs

The largest amount of polychlorinated biphenyls (PCBs) still in use is in electrical equipment, and when it is replaced, owners of that equipment must conform to strict regulations for its disposal. EPRI now provides manuals for managing all aspects of PCB detection and disposal, has sponsored development of a variety of new instruments for measuring PCB contamination, and is conducting a search for suitable substitute insulation fluids. The manuals present detailed methods for PCB

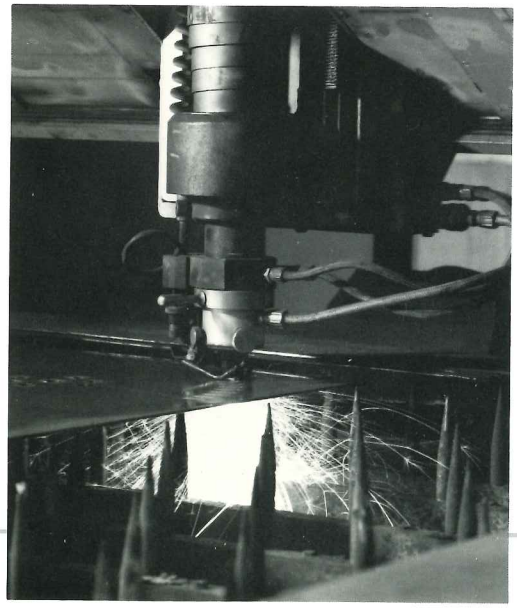


disposal, designs for facilities that reduce airborne PCB contamination, and a guide to the toxicity of potential substitutes for PCBs. Clor-N-Oil, a simple field test kit developed by EPRI, is now available for screening PCB content in transformer oils. Tests conducted with the kits cost approximately $4 per sample, compared with about $40 for more-complete laboratory tests. The kits are selling at a rate of about 20,000 a month to almost all major utilities. Commercial production of the EPRI prototype PCBA-102 gas chromatograph, the first portable instrument for measuring PCB concentration in soils at the site of a transformer leak, also began in late 1984. (RP1263, RP1713, RP2028) □

Center for Metals Fabrication

R&D for Improving Industrial Productivity

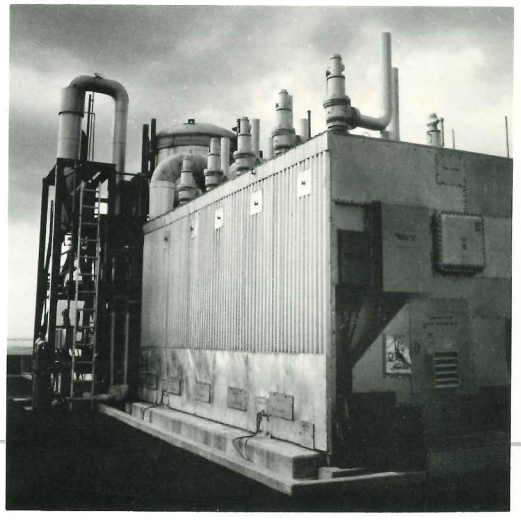
As part of a broader effort to explore electricity's role in improving American industrial productivity, EPRI has established the Center for Metals Fabrication to provide information and assistance to manufacturers on electricity-based processes and equipment that offer greater efficiency and productivity. Current programs at the center, which is based at Battelle, Columbus Laboratories, focus on metal heating, fabrication, and metal removing and finishing. Studies based on industry-defined needs become the basis for seminars, publications, and training programs to guide metal-fabricating firms in selecting new technologies and refining traditional methods that in many cases can improve plant energy efficiency 10–40%. The center's first product, CADNC, is a software program that offers inexpensive computer-aided design and machine tool control for various machining operations. In its first commercial application, a custom saw manufacturer used CADNC to reduce the cost of designing and laser-cutting saw blades by 20%. (RP2478) □



Fuel Cells

Modular Power Plants Downtown

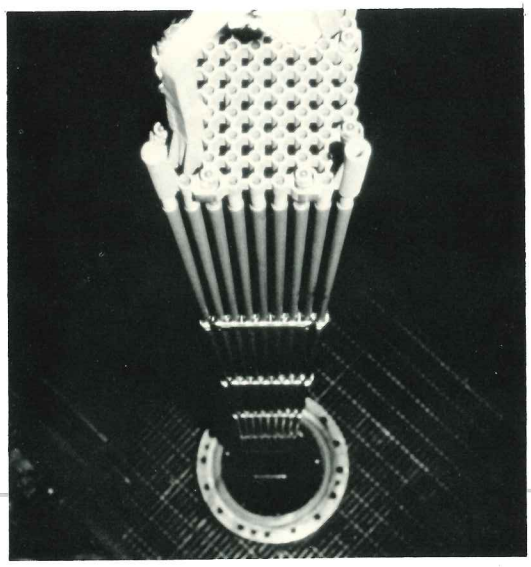
To meet expected demand growth in urban areas beginning in the late 1980s, efforts have been under way for several years to commercialize fuel cell power plants that would be suitable for location in densely populated areas. Because fuel cells convert fuel to electricity directly, without the need for combustion, they produce virtually no air pollutants and can operate with unparalleled efficiency on a variety of fuels. The modular nature of these plants will also allow utilities to add capacity only as needed. As part of the continuing commercialization effort, twin 4.8-MW demonstration plants were scheduled for construction in Japan and the United States. The Tokyo plant has been operating successfully since 1983, but the New York plant, built in part with EPRI funds, was delayed by permit requirements and component failures. As a result, the shelf life of the fuel cell stacks was exceeded, the plant was not able to generate power, and the project has been mothballed. On the basis of the success of the Tokyo plant, however, a new Japanese-American venture company has been formed to build commercial fuel cells, and EPRI is working with utilities to cooperate in installing these prototypes. (RP842) □



High-Burnup Fuel

Longer Life for Nuclear Fuel

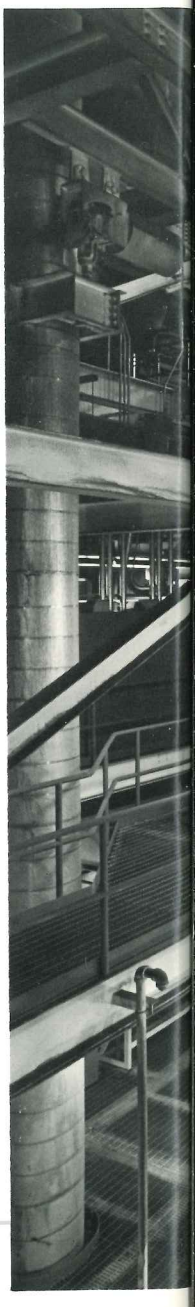
The cost of generating power from a nuclear plant depends on how well uranium resources are used and how frequently the reactor must shut down for refueling. Traditionally, nuclear reactors have been operated with 12-month refueling intervals. EPRI is now analyzing and field-testing high-burnup nuclear fuels that can substantially increase energy extraction and be used with longer cycles, which may improve plant availability by increasing the time interval between refueling. One example is a BWR fuel assembly containing rods in a 9 × 9 configuration rather than the usual 8 × 8. Because of the greater number of rods, the fuel operating temperatures are lower for a given fuel assembly power level. EPRI is demonstrating the new design in a commercial reactor, and Commonwealth Edison Co. has adopted this technology by specifying 9 × 9 assemblies in its current fuel reload order for Dresden units 2 and 3. By using these and other improvements in fuel designs, an estimated 46% of boiling water reactors and 89% of pressurized water reactors could increase average fuel burnup at discharge by 30%. (RP1581) □



Fluidized-Bed Combustion

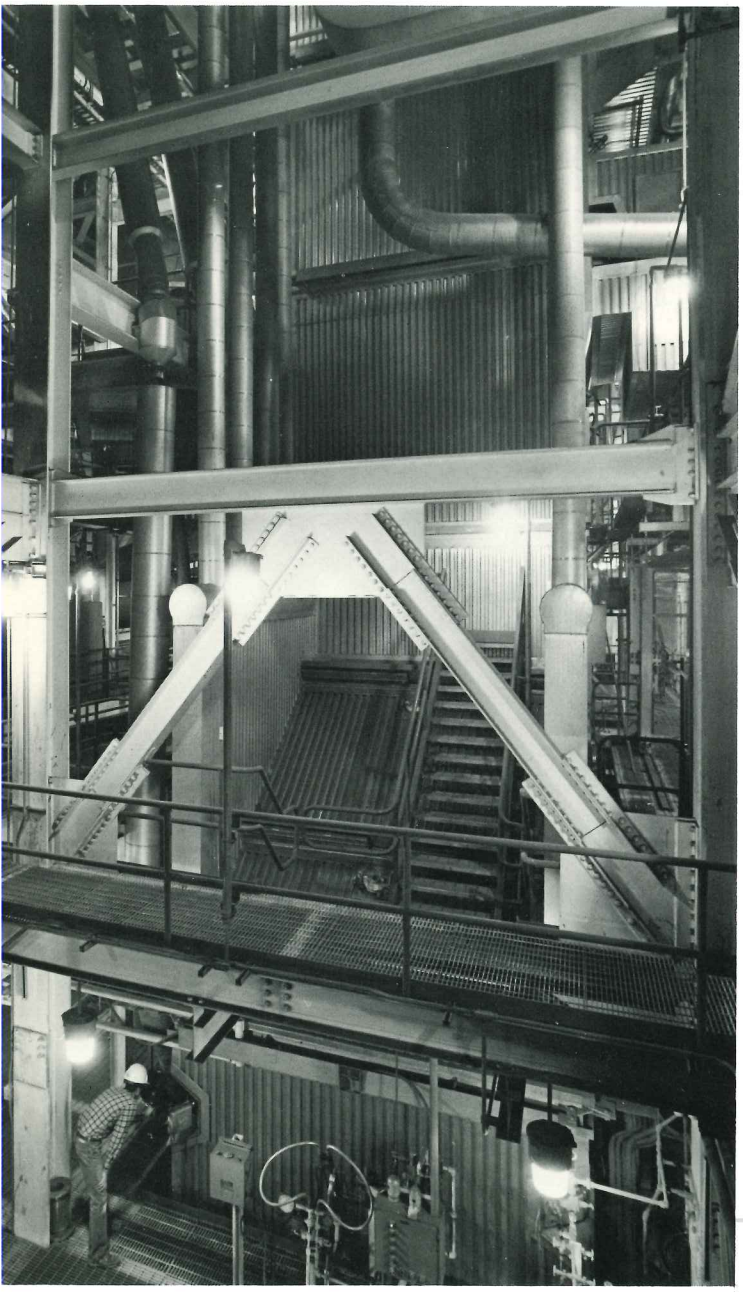
Utility FBC Demonstrations Under Way

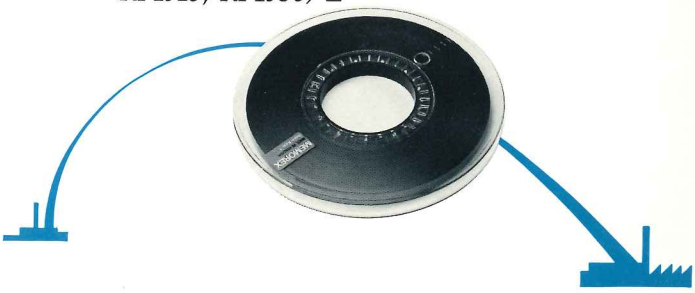
Three utility-scale demonstrations of one of the keystone clean coal technologies for the future—fluidized-bed combustion—were initiated in 1984 with EPRI support. The demonstration plants will be operating by the end of this decade, providing the technical and economic basis for confident, large-scale commercial application of FBC utility systems. Tennessee Valley Authority will add a new 160-MW fluidized-bed boiler to its Shawnee steam plant in Kentucky, the site of a TVA–EPRI 20-MW FBC pilot plant that has played a pathfinder role in design of the current utility projects. In addition, Northern States Power Co. is retrofitting a 125-MW fluidized-bed combustor to an existing conventional pulverized-coal-fired boiler in Minnesota. And Colorado-Ute Electric Association is upgrading its Nucla station with a new 110-MW FBC boiler. Meanwhile, R&D efforts continue on a form of FBC technology known as pressurized fluidized bed that promises a modular plant design for adding small increments of generating capacity. (RP2543, RP2628, RP2683) □



Transferring Demand Experience

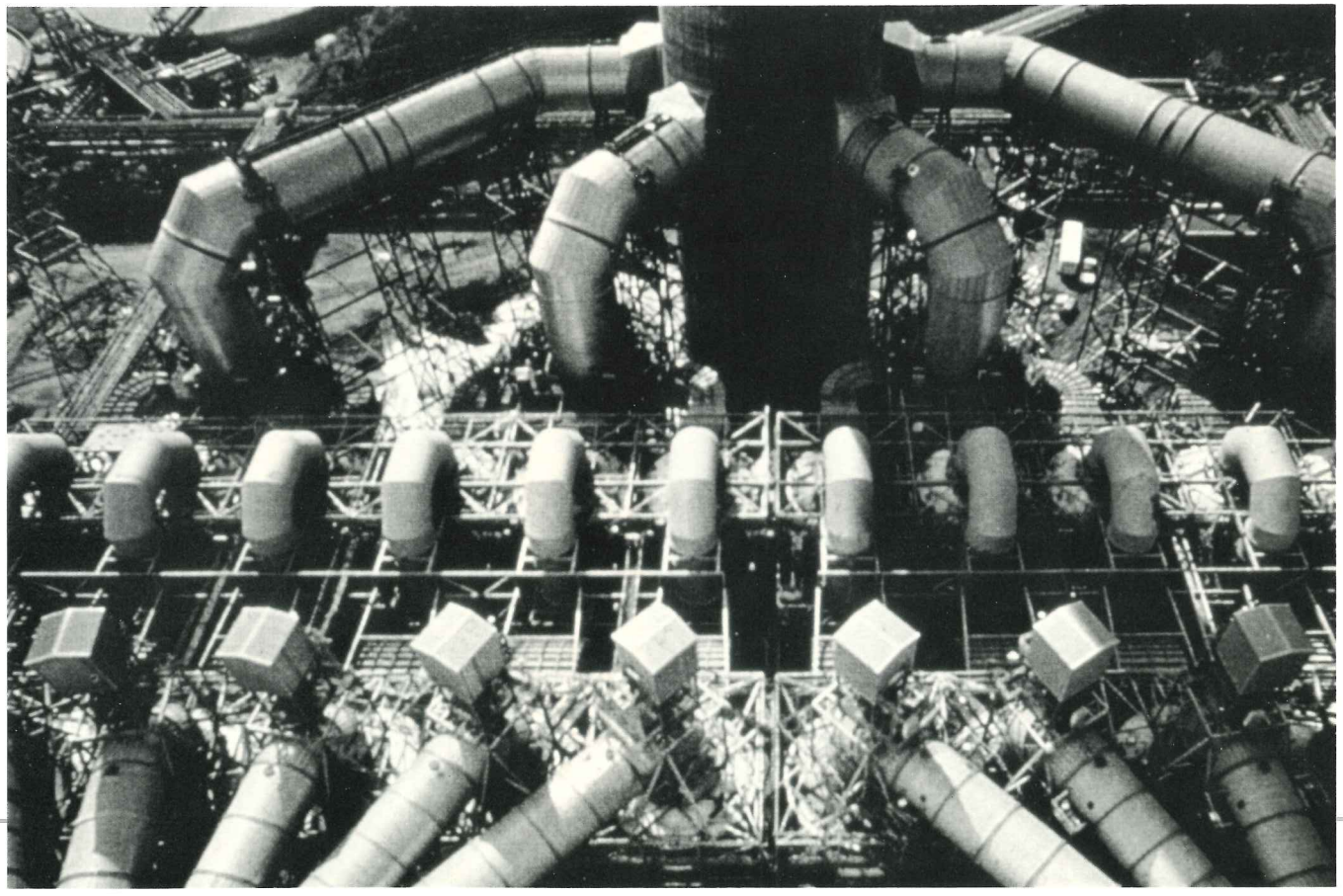
When utilities plan new programs in demand-side management, they often look to other utilities with similar programs in place to estimate customer participation levels and load impacts. But differences in fuel and electricity prices, service area demographics, and weather can greatly complicate the transfer of program results from one utility to others. A group of EPRI projects have dealt with the transferability of demand-side program results. Three residential models have been estimated and validated for analyzing conservation programs, future energy consumption, and customer response to time-of-use rates. The EPRI work indicates that estimates of customer response to such programs can be reliably transferred if proper allowance is made for the key response-conditioning variables. Thus, utilities can benefit from the experience of other utilities and design demand-side management strategies with a reasonable expectation of results, while minimizing the analysis requirements for a specific service area. (RP1211, RP1587, RP1918, RP1956) □





Improving FGD System Availability

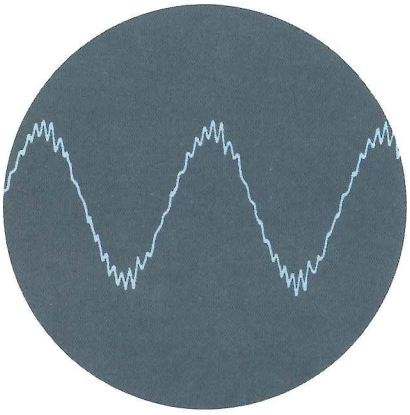
The complex chemical environment inside a coal-fired generating plant's flue gas desulfurization (FGD) equipment can lead to corrosion, erosion, and plugging of key components. Such effects are the leading causes of reduced FGD system availability, which, in turn, affects the availability of generating capacity. New FGD chemistry analytic methods and corrosion-resistant materials are being developed by EPRI to ensure scrubber performance and longevity. A comprehensive laboratory and field research program to determine the chemistry and corrosion problems and to identify solutions is helping utilities select the most cost-effective FGD system designs. A new manual on scrubber chemistry pinpoints the factors that cause high reagent requirements, plugging, and other problems. Field tests of materials have shown that certain high-nickel alloys, titanium, and alloy 255 have good resistance to pitting and general corrosion. Each material has an estimated useful life expectancy of over 30 years, in contrast to currently used materials that can fail in less than 5 years. Such advances in chemistry and materials can reduce FGD operating, maintenance, and capital costs and can improve reliability. Resolution of FGD chemistry problems at two full-scale wet-FGD sites is now saving $10 million a year, while the materials saving at a single utility has been estimated at over $17 million. (RP1031, RP1871, RP2248) □



Power System Software

Diagnosing Power Line Harmonics

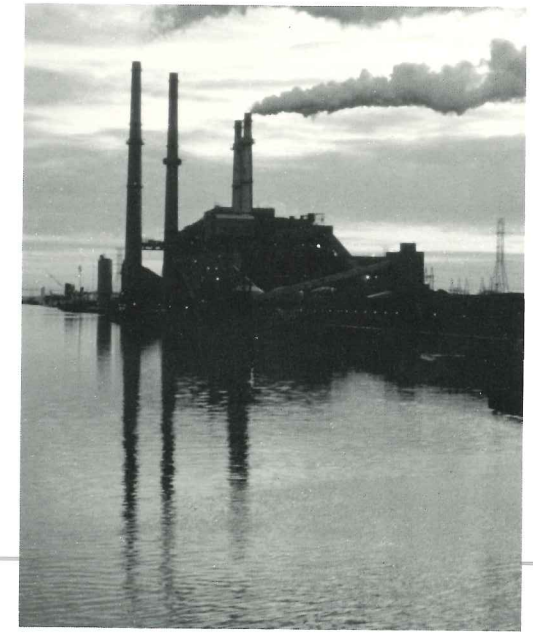
An increasing number of loads connected to power systems can distort the standard sine wave characteristic of line voltage and current by adding higher-frequency harmonics. Examples of such loads include rectifiers, variable-speed motor drives, welding machines, and high-voltage direct-current equipment. Harmonics in a line can trip circuit breakers, overheat transformers, cause capacitor bank failure, and interfere with the operation of such susceptible end-use equipment as computers. To help utilities diagnose problems caused by harmonics, EPRI has developed a new code, HARMFLO, which is a significant improvement over previous methods of analysis. This code is designed to model harmonics caused by specified loads, determine how they will propagate, and how harmonics from different sources will interact. The code has already been applied to assess potential effects of a plasma arc heater installation in Minnesota and to locate sources of harmonics interfering with air traffic control radar at the Dallas–Fort Worth airport. (RP1764) □



Power Generation

Tools for Improving Plant Availability

Ensuring the availability of future generating capacity under present industry financial constraints means an increased focus on improving the performance of existing power plants. Here, combining research results with established engineering practices can yield significant near-term benefits. In the past year numerous products for enhancing power plant availability have been completed, including a manual on chemical cleaning techniques for fossil-fuel-fired boilers and other equipment. A manual on boiler tube failures helps plant operators identify the root cause of failures. An acoustic leak detector has been developed for locating primary tube leaks to prevent and reduce secondary failures. New methods for evaluating the remaining life of fossil fuel plant components have become important tools for plant life extension. For both fossil fuel and nuclear plants, the modular modeling system computer code can simulate the dynamic behavior of entire plants or subsystems under a variety of conditions. □



Corporate Planning

A Comprehensive Planning Model

For some time utilities have needed a comprehensive planning model that can cover all their functions and complement existing, more-detailed models of particular business activities. The new utility planning model (UPM), developed by EPRI and now available through its Electric Power Software Center, helps meet this need by providing an integrated, long-term corporate planning system. Because UPM is completely integrated, utilities can use it to link supply, demand, financial, and regulatory planning. The model can simulate the entire sequence of a utility's functions for periods of 5, 10, 20, or more years. Optional feedback capabilities enable a user to adjust demand growth in response to changes in production costs or to adjust construction schedules in light of financial changes. So far the UPM code has been distributed to about 25 utilities. In addition to providing a state-of-the-art improvement in corporate planning capabilities, the model is leading to substantial savings by streamlining planning requirements. (RP1819) □

TLMRF

Testing Transmission Structures

During its first full year of operation, EPRI's Transmission Line Mechanical Research Facility (TLMRF) has been used to test a variety of existing transmission structures and to conduct research on new structure designs. Under cosponsor testing agreements, several utilities and one manufacturer brought 11 different structures to the facility in 1984, where 15 separate tests were conducted. These structures included both wood and steel poles as well as conventional lattice towers. The failure of several of these structures at stress levels below their design limits indicated the need to change specific assumptions used in previous design techniques. New analytic methods are being explored, based on a growing data base of test results. In late 1984 construction was also begun on the first research test line at TLMRF, with initial tests on the line scheduled for the second quarter of 1985. Results of research at TLMRF are already being used by utilities to upgrade existing lines and to design new, more cost-effective transmission structures. (RP1717, RP2016) □

FINANCIAL REPORT

- Statement of Financial Position
- Statement of Revenues and Expenses and Changes in Fund Balances
- Statement of Changes in Financial Position
- Notes to Financial Statements
- Report of Independent Accountants

Electric Power Research Institute, Inc.
Statement of Financial Position
December 31 (thousands of dollars)

	1984		1983	
	Base Program	Separately Funded Programs	Base Program	Separately Funded Programs
ASSETS				
Current assets:				
Cash and short-term marketable securities (Note 2)	$ 41,881	$10,809	$ 33,786	$10,726
Amounts due from members	6,650	3,464	4,209	1,127
Accrued interest receivable	534	–	276	–
Other current assets	3,304	72	3,356	11
	52,369	14,345	41,627	11,864
Property, facilities, and equipment, net of accumulated depreciation and amortization (Note 3)	36,418	–	37,347	–
Funds held by trustee (Note 4)	2,263	–	4,920	–
Total assets	91,050	14,345	83,894	11,864
LIABILITIES				
Current liabilities:				
Research and development expenses payable	90,776	5,307	81,708	4,244
Accounts payable and other accrued liabilities	6,248	829	7,981	1,032
Current portion of long-term debt and obligation under capital lease (Notes 4 and 5)	2,051	–	1,889	–
Interest payable	602	–	626	–
	99,677	6,136	92,204	5,276
Long-term research and development expenses payable	1,327	102	1,158	7
Long-term debt (Note 4)	22,982	–	24,982	–
Obligation under capital lease (Note 5)	3,476	–	3,528	–
Total liabilities	127,462	6,238	121,872	5,283
Commitments (Notes 5 and 6)				
FUND BALANCE (DEFICIT)	$(36,412)	$ 8,107	$(37,978)	$ 6,581

See accompanying notes to financial statements.

Electric Power Research Institute, Inc.
Statement of Revenues and Expenses and Changes in Fund Balances
Years Ended December 31 (thousands of dollars)

	1984		1983	
	Base Program	Separately Funded Programs	Base Program	Separately Funded Programs
REVENUES				
Industry payments (Note 11)	$302,930	$21,048	$284,672	$14,395
Interest income	5,235	1,159	4,998	1,198
Other income	1,195	3	2,981	11
Total revenues	309,360	22,210	292,651	15,604
EXPENSES				
Research and development (Notes 9 and 10)				
Contract	248,861	18,262	270,423	10,906
In-house	4,256	–	4,398	–
R&D planning, management, and applications	36,305	1,549	34,081	1,327
	289,422	19,811	308,902	12,233
Technical and industry information	5,728	291	6,157	241
General and administrative	12,644	582	11,534	481
Total expenses	307,794	20,684	326,593	12,955
EXCESS (DEFICIENCY) OF REVENUES OVER EXPENSES	1,566	1,526	(33,942)	2,649
FUND BALANCE (DEFICIT), BEGINNING OF YEAR	(37,978)	6,581	(4,036)	3,932
FUND BALANCE (DEFICIT), END OF YEAR	$ (36,412)	$ 8,107	$ (37,978)	$ 6,581

See accompanying notes to financial statements.

Electric Power Research Institute, Inc.
Statement of Changes in Financial Position
Years Ended December 31 (thousands of dollars)

	1984		1983	
	Base Program	Separately Funded Programs	Base Program	Separately Funded Programs
Cash was provided (used) by operations:				
Excess (deficiency) of revenues over expenses	$ 1,566	$1,526	$(33,942)	$ 2,649
Add (deduct) items not affecting cash in the period:				
Depreciation and amortization	3,626	–	2,799	–
Decrease (increase) in amounts due from members	(2,441)	(2,337)	12,657	(156)
Decrease (increase) in other current assets except cash and short-term marketable securities	(206)	(61)	623	90
Increase (decrease) in liabilities excluding debt and capital lease	7,480	955	(3,201)	(9,794)
Total	10,025	83	(21,064)	(7,211)
Cash was used for:				
Additions to property, facilities, and equipment	2,697	–	4,678	–
Payment of long-term debt	1,890	–	1,742	–
Total	4,587	–	6,420	–
Increase (decrease) in cash and short-term marketable securities before financing activities	5,438	83	(27,484)	(7,211)
Financing activities:				
Bond proceeds	–	–	14,000	–
Withdrawal from (deposit with) bond trustee	2,657	–	(2,365)	–
Increase (decrease) in cash and short-term marketable securities	$ 8,095	$ 83	$(15,849)	$(7,211)

See accompanying notes to financial statements.

NOTE 1—Description of organization, mission, and summary of significant accounting policies:

Organization

The Electric Power Research Institute, Inc. (the Institute), was organized in 1972 under the District of Columbia Nonprofit Corporation Act. The mission of the Institute is to conduct a national research and development program relating to the production, transmission, distribution, and utilization of electric energy. The Institute's activities include technological assessment of both near-term and long-term research needs, their arrangement into an orderly strategic plan, the assignment of priorities and allocation of funds, the implementation and management of the resultant projects (which, for the most part, are performed by independent contractors), and dissemination of the information gained. These activities are carried out under the sponsorship of the public, private, and cooperative sectors of the U.S. electric utility industry and constitute the base program for the Institute (Base Program). In addition to the Base Program, the Institute is managing seven separately funded research efforts: the Boiling Water Reactor Owners Group Intergranular Stress Corrosion Cracking Program (ISCCP), the Steam Generator Owners Group Program (SGP), the Seismicity Program (SP), the Hydrogen Control Program (HCP), the Nuclear Fuel Industry Research Program (NFIR), the Pressurized Water Reactor Safety and Relief Valve Program (RVP), and the Utility Acid Precipitation Study Program (UAPSP).

Summary of Significant Accounting Policies

The Institute employs the accrual basis of accounting and, accordingly, records contribution commitments as revenue in the year to which the commitment relates; records interest as income when earned; and records research and development expenses and management expenses as they are incurred. Management expenses have been classified into three categories beginning in 1984: R&D planning, management, and applications; Technical and industry information; General and administrative. The financial statements for 1983 have been restated for comparability.

Under some research contracts, the Institute agrees to reimburse its contractors for the cost of specialized equipment needed to perform the work. In these cases, it is the Institute's policy to retain title to such equipment and to charge to expense the cost thereof when invoiced by the contractor. At the conclusion of the contract, equipment may be transferred to other work. Otherwise, the proceeds, if any, from the sale or other disposition of the equipment are credited to other income.

The cost of buildings under capitalized lease and land leaseholds used in the management of research projects is amortized over the respective lease terms. Depreciation is computed by using the 150% declining-balance method for buildings and the straight-line method for land leaseholds. Equipment and leasehold improvements are capitalized when the acquisition cost of an item exceeds $5,000 and has a useful life greater than one year; depreciation is computed by using the straight-line method over their expected useful lives. Structures and equipment having an individual cost exceeding $250,000 and used in conducting multiple research projects are capitalized; depreciation is computed by using the straight-line method over their expected useful lives. Costs associated with individual research and development projects conducted at these facilities are charged to expense as incurred.

Management expenses incurred by the Institute are allocated to the Base Program research activities and to the separately funded programs.

NOTE 2—Cash and short-term marketable securities:

Cash and short-term marketable securities, at cost that approximates market, were as follows.

	1984	1983
	(thousands of dollars)	
Cash	$ (943)	$ 395
Bankers acceptances and certificates of deposit	1,965	13,903
Commercial paper	51,668	30,214
	$52,690	$44,512

It is the Institute's current policy to solicit contributions for the Base Program from its members each year only for the funds required for that year's total estimated cash disbursements. Through January 31, 1985, members have committed $304,973,000 for 1985 cash disbursements. For 1985, member payments are scheduled to be received in

four equal quarterly installments, due in the first month of each quarter.

The Institute also has a $25,000,000 unsecured line of credit available from its principal bank. There were no borrowings outstanding under this line of credit during 1984 or 1983.

NOTE 3—Property, facilities, and equipment:

	1984	1983
	(thousands of dollars)	
Buildings and land leases	$37,984	$37,888
Equipment and leasehold improvements	8,900	6,523
Construction in progress	224	–
	47,108	44,411
Accumulated depreciation and amortization	(10,690)	(7,064)
	$36,418	$37,347

NOTE 4—Long-term debt:

	1984	1983
	(thousands of dollars)	
Mortgage	$ 2,087	$ 2,123
Bonds	22,895	24,700
	24,982	26,823
Less current portion	(2,000)	(1,841)
	$22,982	$24,982

The mortgage loan is secured by a deed of trust on one of the buildings, which has an aggregate cost of $2,299,000. The loan is payable in equal monthly installments, including interest to 2004, and bears interest at the rate of 9% per annum. Interest cost on this loan was $190,000 in 1984 and $193,000 in 1983.

In 1979, the Institute entered into a contract for the construction of a facility near Homer City, Pennsylvania, to be used in conducting research involving coal-cleaning methods. Construction was financed from the proceeds of $13,900,000 of tax-exempt Industrial Development Revenue Bonds issued by the Indiana County Industrial Development Authority, which are secured by a Crocker National Bank eight-year irrevocable letter of credit. The bonds bear interest at 8⅜% and are subject to mandatory redemption as follows.

1985	$1,960,000
1986	2,125,000
1987	2,305,000
1988	2,505,000
	$8,895,000

Total 1984 and 1983 interest cost for the bonds was $821,000 and $966,000, respectively, and is included in contract research and development expenses. There is an interest and call premium reserve of 13% on the outstanding balance.

In 1983, the Institute completed the construction of a facility near Haslet, Texas, which is used for research involving the testing of transmission lines. The facility was financed through the proceeds of $14,000,000 of tax-exempt Industrial Development Revenue Bonds issued by the Haslet Industrial Development Authority. The bonds are secured by an irrevocable letter of credit for 10 years from the Manufacturers Hanover Trust Co. The bonds bear interest at 9¼%, and the entire obligation is due at the end of the 10-year term. The Institute makes interest payments through the Trustee semiannually. Total 1984 and 1983 interest cost was $1,295,000 and $457,000, respectively, and is included in research and development costs.

Each irrevocable letter of credit is subject to certain covenants. These include maintaining (a) relationships of long-term debt to annual revenues, annual principal and interest payments on long-term debt to annual revenues, and the sum of cash, marketable securities, and total member commitments to current liabilities and (b) member commitments in excess of a specified amount.

At December 31, 1984, $2,263,000, representing the remaining proceeds, the reserve, and related interest earned, was on deposit with the Trustee in accordance with each Trust Indenture established at the time of the issuance of the bonds.

NOTE 5—Commitments:

The Institute has entered into lease arrangements under operating leases for research, office, and storage facilities and for equipment. Rental expense under these leases was $1,489,000 in 1984 and $1,437,000 in 1983.

The terms of certain of these leases provide that the Institute is liable for property taxes, insurance, and maintenance expenses, and in certain cases, renewal options are included.

The Institute leases certain buildings under a long-term noncancelable lease, which is treated as the acquisition of an asset and the incurrence of a liability (Obligation under capital lease). The lease has an initial term of 30 years, expiring in 2008, and options to renew for two successive 10-year periods. The last 10-year option is subject to rental renegotiation. The capitalized cost of $3,807,000 is included in Buildings and land leases (see Note 3).

Future minimum lease commitments by year and in the aggregate, under the capital lease and noncancelable operating leases with initial terms of one year or more, at December 31, 1984, were as follows.

	Capital Lease	Operating Leases	Total
		(thousands of dollars)	
1985	$ 336	$1,449	$ 1,785
1986	336	1,490	1,826
1987	336	938	1,274
1988	336	481	817
1989	336	481	817
Thereafter	6,240	481	6,721
	7,920	$5,320	$13,240
Less amount representing interest	(4,393)		
Present value of the minimum capital lease commitment	$3,527		

Interest cost on the capital lease was $288,000 in 1984 and $292,000 in 1983.

NOTE 6—Research funding:

As the Institute identifies prospective research projects, the maximum amounts that may be expended on such projects are authorized annually. One responsibility of the Institute's staff is to negotiate research contracts with companies and organizations that result in a contractual commitment for a given year. Such commitments cannot exceed the cumulative authorization.

At December 31, 1984, the Institute had commitments with contractors for reimbursement of future research costs in the amount of approximately $100,000,000. Generally, the Institute has the right to cancel research and development contract commitments on 30 days' notice.

NOTE 7—Income tax status:

The Institute has been determined to be exempt from federal income taxes as a scientific organization under Section 501(c)(3) of the Internal Revenue Code. Hence, only unrelated business income, as defined in the Code, is subject to federal income taxes. In 1984, as in prior years, the Institute had no taxable income.

NOTE 8—Pension plans:

The Institute has one pension plan for its employees, a defined contribution plan, which conforms in all material respects to the provisions of the Employee Retirement Income Security Act of 1974. It is the Institute's policy to fund pension costs accrued. Pension expense was $3,200,000 for 1984, compared with $2,994,000 for 1983.

NOTE 9—Research and development expenses:

Research and development expenses for the Base Program were as follows.

	1984	1983
	(thousands of dollars)	
Advanced Power Systems	$ 39,981	$ 53,610
Coal Combustion Systems	49,574	45,719
Electrical Systems	35,600	35,355
Energy Analysis and Environment	35,914	33,571
Energy Management and Utilization	25,882	31,969
Nuclear Power	61,647	69,641
Other divisions	4,519	4,956
R&D planning, management, and applications	36,305	34,081
	$289,422	$308,902

Beginning in 1984, R&D planning, management, and applications has been classified as part of research and development expense. The 1983 amounts have been reclassified to reflect this change (see Note 1). In 1984 the Institute refined its method of allocating certain in-house research and development costs. As a result of this change, amounts for 1983 have been increased by $2,453,000.

NOTE 10—Separately funded programs:

Revenues and expenses for separately funded programs for the years ended December 31 were as follows (thousands of dollars).

	1984						1983
	ISCCP	SGP	SP	HCP	Other	Total	Total
REVENUES							
Industry payments	$6,201	$9,083	$1,715	$2,430	$1,619	$21,048	$14,395
Interest income	56	833	139	4	127	1,159	1,198
Other income	3	–	–	–	–	3	11
Total revenues	6,260	9,916	1,854	2,434	1,746	22,210	15,604
EXPENSES							
Research and development							
Contract	4,511	7,974	2,365	1,966	1,446	18,262	10,906
In-house	–	–	–	–	–	–	–
R&D planning, management, and applications	306	863	192	150	38	1,549	1,327
	4,817	8,837	2,557	2,116	1,484	19,811	12,233
Technical and industry information	58	161	36	30	6	291	241
General and administrative	115	322	73	60	12	582	481
Total expenses	4,990	9,320	2,666	2,206	1,502	20,684	12,955
EXCESS (DEFICIENCY) OF REVENUES OVER EXPENSES	1,270	596	(812)	228	244	1,526	2,649
FUND BALANCE (DEFICIT), BEGINNING OF YEAR	(1,300)	5,811	741	142	1,187	6,581	3,932
FUND BALANCE (DEFICIT), END OF YEAR	$ (30)	$6,407	$ (71)	$ 370	$1,431	$ 8,107	$ 6,581

NOTE 11—Industry payments:

Industry payments for the years ended December 31 were as follows (thousands of dollars).

	1984		1983	
	Base Program	Separately Funded Programs	Base Program	Separately Funded Programs
U.S. electric utilities				
Investor-owned corporations	$265,692	$17,372	$248,379	$ 9,984
Nonfederal government agencies	20,534	394	20,182	224
Federal government agencies	10,236	288	10,024	164
Cooperatives	6,468	139	6,087	80
Other sources	–	2,855	–	3,943
	$302,930	$21,048	$284,672	$14,395

REPORT OF INDEPENDENT ACCOUNTANTS

To the Board of Directors of Electric Power Research Institute, Inc.

In our opinion, the accompanying statement of financial position and the related statements of revenues and expenses and changes in fund balances and of changes in financial position present fairly the financial position of Electric Power Research Institute, Inc., both as to the Base Program and as to the Separately Funded Programs, at December 31, 1984 and 1983, and the results of its operations and the changes in its financial position for the years then ended, in conformity with generally accepted accounting principles consistently applied. Our examinations of these statements were made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances, including at December 31, 1984 and 1983, confirmation of cash and securities owned by correspondence with the depositaries.

Price Waterhouse

San Jose, California
March 1, 1985

ELECTRIC POWER RESEARCH INSTITUTE, INC.

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