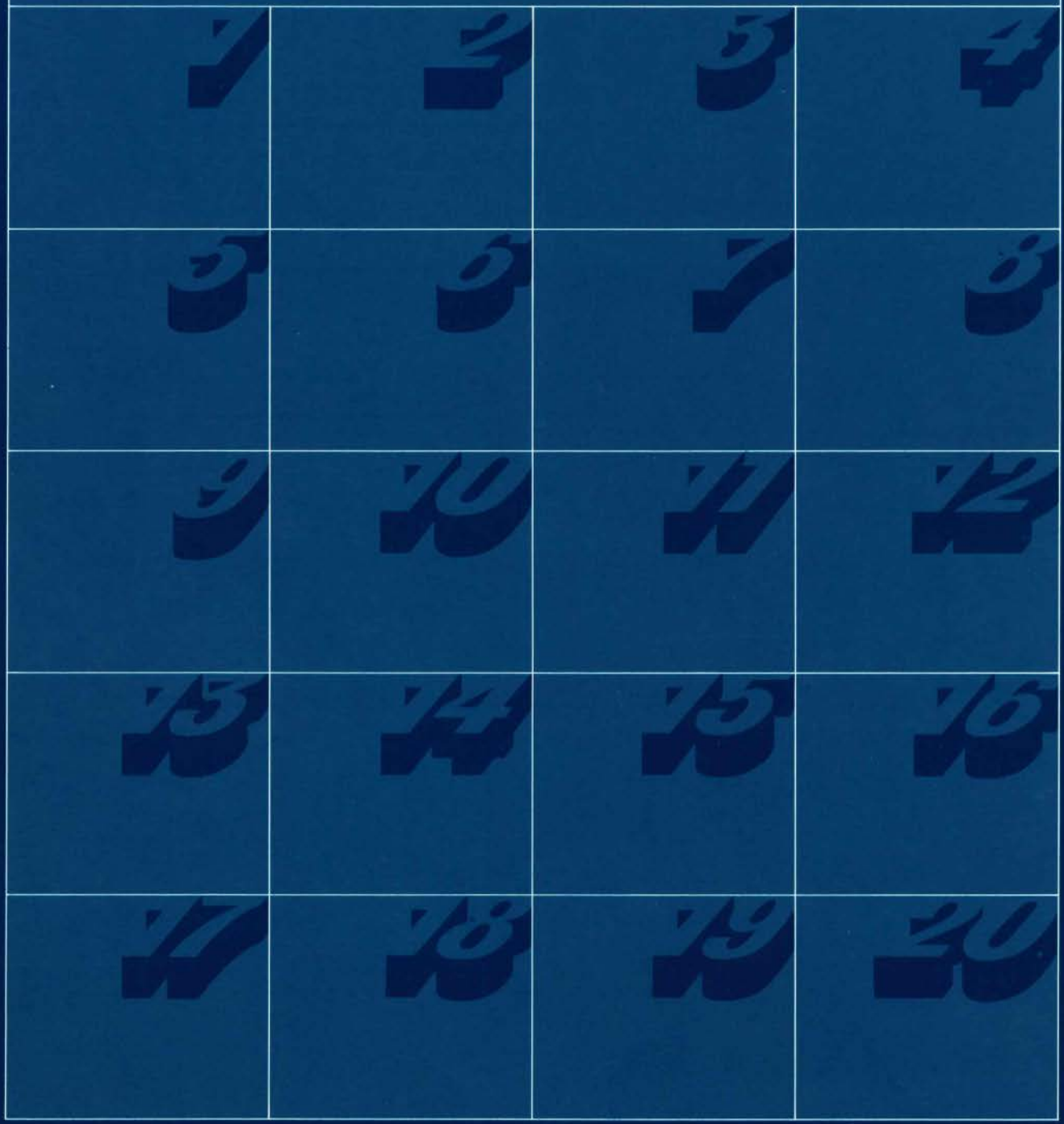
1983 ANNUAL REPORT ELECTRIC POWER RESEARCH INSTITUTE

Responses to Utility 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 497 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 1983 payments to EPRI, based on business volume, totaled $285 million.

Nationwide in scope, EPRI 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

A year ago these pages recapitulated the changes of EPRI's first 10 years. Now, I think, it is worthwhile to ask what the next 10 may bring. Prospects for the national economy suggest a rate of growth in electricity use exceeding the average of the past decade. This is basically good news, but its ramifications define problems that we face and with which EPRI will be involved on our behalf.

Our technological course will be heavily influenced by the availability of two principal energy resources. Coal, I believe, will remain number one, not just for the next 10 years but throughout the rest of the twentieth century. Nuclear power will continue to be an uncertain option, particularly in the next 5 years; but it will eventually reemerge, perhaps in a little different form technologically or institutionally.

Environmental improvements of all kinds will continue to have broad support, and I foresee pressure for more-stringent controls. Concern is newly focused, in fact, on water quality and the disposal of toxic wastes. Relative to other industries, electric utilities are not a special target in this regard, but the potential exists and our conscientious R&D continues to be a wise investment.

Two EPRI project milestones of 1983 were examples of major R&D progress in cleaner coal-based technologies for electricity generation. One was the qualification of our Cool Water demonstration project for up to $120 million in federal price supports for the clean gaseous fuel it will produce. The other—this one a specific action of the EPRI Board—was approval of $75 million in funding to demonstrate the atmospheric fluidized-bed combustion of coal at a plant capacity scale of 160 MW.

Electricity growth in the next several years will not be an untarnished blessing. Utilities will continue to be under economic and regulatory pressure to improve productivity. Better cost-effectiveness can be expected to proceed from EPRI's technological innovation, but our thinking must also include managerial innovation in every aspect of utility operations.

Such pressures on our industry clearly translate into budget pressures on EPRI. There will be resistance to a significant increase in the formula for EPRI membership revenues. This constraint will be accompanied by a perceived need to make up for declines in R&D funding by the federal government and by industry manufacturers whose business opportunities have been slim in recent years. EPRI will therefore have to do an even better job of setting priorities for research. It will have to say no at times, even when that contradicts the strong sentiments of one or even several members.

By the end of 1984 EPRI's management and directors should have some special insights into ways for meeting these challenges. As decided in December 1983, a review of the Institute's effectiveness will occupy much of the Board's time this year. A Board subcommittee has the major role, a consultant may play a limited part, and we have invited the Advisory Council to work with us in the evaluation process. Such periodic self-examination is a wise move, last commissioned by EPRI's Board in 1977. Are we doing the right things? Are they being done effectively? What can we do to improve? Working closely with EPRI management, we expect an open and constructive process.

The review should also clarify many points where there are different perceptions about EPRI's role. The question of emphasis on end-use R&D—a major matter of Board discussion in 1982—has already been resolved by compromise: the affirmation of a relatively modest funding level. As another example, the tilt toward near-term R&D objectives is sometimes questioned. This results from external pressures that will prove to be cyclic, it seems to me; and within the next 10 years EPRI should again be able to put more of its effort into longer-term needs.

We also hear expressions of deep concern over whether EPRI should become heavily involved in large demonstration-size projects. As a Board, we have most often concluded that these ventures are the best way to share risk at near-commercial scale. To me, sharing makes special sense today, when each utility's ability to take risks is already limited by such a variety of economic factors.

Aside from the issues of any single technology or policy context, we realize that divergent opinion is to be expected in a large membership organization; the important thing is to have the setting and the process for working through it. I believe EPRI provides both, enabling utility R&D progress to proceed on its merits, seldom by resort to compromise, most often by confident consensus.

A. J. Pfister
Chairman

PRESIDENT'S MESSAGE

The year 1983 was a mixture of good and bad for the electric utility industry. On the positive side, generation of electricity increased by about 3.5% over the previous year, partly because of the upturn in the economy and partly because of a cold winter and a hot summer. The biggest problems for the industry arose from concern over the environmental effects of acid rain and restrictions on nuclear power.

The coal-burning utilities are caught in a maelstrom of science, politics, and proposed solutions over the issue of acid rain. Public concerns and the drive for regulatory action are running ahead of the knowledge needed to solve the problem. EPRI research seeks answers to the questions on acid rain through better scientific understanding and the development of remedial technology. Only by this approach can we hope to solve the problem without creating large new electricity costs for individuals and basic industries struggling to remain competitive.

The year has also seen an increase in the intensity of problems facing utilities that rely on nuclear power. It is because these problems are so well publicized and nuclear power is so important to our energy future that I want to spend a few extra paragraphs on fission power.

I have been shocked by the very high costs that some nuclear plants, started more than 10 years ago, now require. Construction costs have been distorted by an avalanche of regulatory uncertainty, small failures, and financial constraints. Few other industries, in this country or abroad, must endure such restraints.

Because we constantly hear about the nuclear plants where things are not going well, the public may forget that the majority of nuclear plants are operating quite successfully—generally better than other available electric power sources. The best nuclear units are available 80–90% of the time, and capacity factors are nearly as high. Such performance has been attained despite the time consumed in meeting new regulations. These requirements include periodic inspection, testing, special backfits, and paperwork not required for other energy systems. We should also remember that nearly all the nuclear units operating before 1980 still have attractive capital and operating costs. And the majority of units completed since then still have competitive costs.

Almost all EPRI research in the nuclear area is dedicated to improving safety, lowering costs, and increasing reliability of the present generation of reactors. On the basis of this research, nuclear power plants could now be improved in ways that would offer substantial cost and reliability benefits to utilities when new orders pick up. But the future of nuclear power goes beyond such technical issues. Public confidence must also be restored and society must strike a balance between regulatory objectives and financial reality.

In response to escalating costs for new fossil fuel and nuclear plants, utilities have been moving to improve the operation of existing facilities through increases in system efficiency and reliability. They have thus been able to avoid, for a while, the installation of new generating capacity by extending current plant life through conservation, cogeneration, and load leveling. Most of EPRI's R&D effort is directed toward maintaining current capacity and generation capability in fossil fuel, fission, and alternative energy systems.

In this annual report specific examples have been selected from a large array of EPRI-sponsored scientific and technological projects. These programs will provide the technical basis for improving power-generating systems in the future.

Not all our programs focus on current, near-term problems. There are many longer-range opportunities for significant improvements in plant construction costs, in efficiency, and in new design and construction methods. In addition, EPRI is expanding its investigation of how electricity can be used more effectively by industrial and commercial customers. I am particularly excited by the very real promise of increasing the economic efficiency of energy use in some of the basic smokestack industries. Electricity's special attributes can provide new focuses and techniques that will allow traditional industrial commodities to be produced at lower cost.

We are very pleased by the progress being made in advancing new technology for clean coal burning. Demonstration of the gasification–combined-cycle process will begin this spring at the Cool Water plant. Very promising results are being obtained at the 20-MW atmospheric fluidized-bed pilot plant on the TVA system at Paducah, Kentucky. Next, a full-scale modular atmospheric fluidized-bed test plant will be built by Duke Power Co., TVA, EPRI, the state of Kentucky, and other partners. In another important test of this technology, Northern States Power Co. (Minnesota) will retrofit an older pulverized-coal plant with a fluidized bed. Pressurized fluidized beds also look good enough for several companies to seriously study their use. These advanced technologies show every promise of producing power in 200–400-MW (e) plants that will be competitive in cost with standard coal systems equipped with scrubbers.

Many other EPRI-sponsored technologies are coming that will provide the industry with new means for rejuvenation and recovery. Methods for load analysis, financial planning, system expansion, and fuel optimization are coming into wider use. New devices and systems for transmission and distribution are also becoming more broadly available. Such innovations can help utilities and their customers face current problems with increased confidence, while multiplying their opportunities for a promising future.

Floyd L. Culler

Floyd L. Culler
President

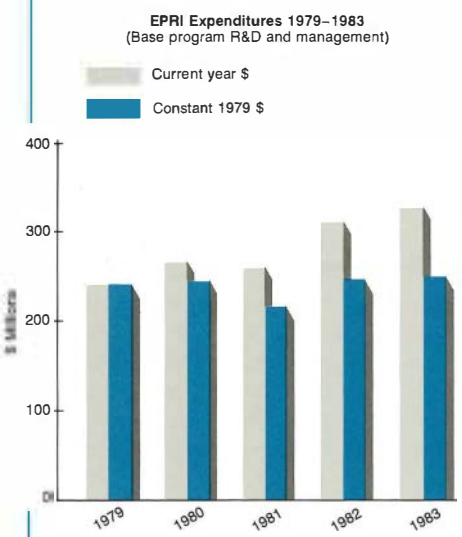
OPERATIONS REVIEW

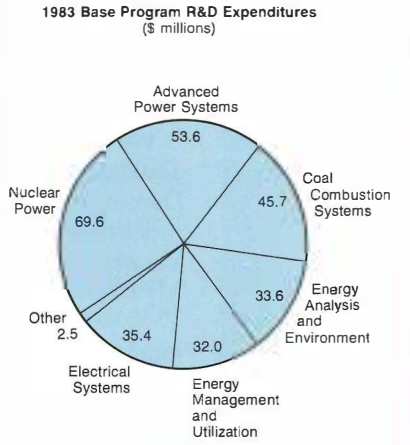
Highlights of 1983

JANUARY

Institute budget up 8% in 1983

Expenditures in 1983 were forecast to be $326 million, $24 million ahead of 1982 and slightly ahead of inflation. Revenues were expected to be virtually unchanged at $285 million. These forecast figures were closely borne out by 1983 year-end results: expenditures were just $327 million (including R&D contract outlays of $272 million), and revenues were slightly ahead of plan at $293 million (including $8 million in interest and other income). As planned, a year-end deficit of $38 million consisted largely of R&D contract costs not yet billed to EPRI. □





Stronger membership policy takes effect

Firm schedules for EPRI member payments, higher charges to non-member utilities, and a members-only rule for participating in the work of advisory committees were introduced to emphasize the benefits of Institute membership. Membership revenue for 1983 ultimately totaled $285 million, up 1% from the year before, despite the loss of several members that had been paying only a portion of the full dues. EPRI's roster fell from 508 utilities to 497; the new total includes 181 investor-owned companies, 134 municipal government agencies, 180 rural electric cooperatives, Bonneville Power Administration, and Tennessee Valley Authority. Despite the change in numbers, EPRI's membership community still delivers about 70% of all U.S. electricity. □

FEBRUARY

Agreement set with Taiwan utility

Taiwan Power Co. became the eleventh foreign institute or government agency with which EPRI has agreed to exchange R&D information, and a program for seismic-effects testing of nuclear power plant structures was announced as the first cooperative activity. Scale models of containment buildings and piping in a highly seismic zone of Taiwan will be instrumented and monitored during both real and simulated earthquakes. Later in the year EPRI also arranged with the Electricity Supply Board of Ireland for a give-and-take of research information. □

APRIL

Institute elects directors

EPRI membership and Board meetings saw two new directors elected, two directors reelected, and A. J. Pfister, general manager of the Salt River Project, elected chairman of EPRI. Pfister succeeded William Gould of Southern California Edison Co. Reelected director Arthur Hauspurg of Consolidated Edison Co. of New York, Inc., was named vice chairman. Barton Shackelford of Pacific Gas and Electric Co. was also reelected to the Board, joined by two new directors, John Selby of Consumers Power Co. and Richard Walker of Public Service Co. of Colorado. At other times during 1983, Peter Johnson was designated to re-

place Earl Gjelde in the standing EPRI directorship accorded to the Bonneville Power Administration; Peter McTague of Green Mountain Power Corp. resigned; Frank Griffith of Iowa Public Service Co. resigned and later accepted reappointment; and Paul Ziemer of Wisconsin Public Service Corporation accepted appointment until the 1984 annual meeting. □

MAY

EPRI and INPO coordinate efforts

Regular exchanges of program details and the assignment of liaison responsibilities in ten professional areas of EPRI's Nuclear Power Division and the Institute of Nuclear Power Operations were proposed as ways to coordinate work by the two organizations. Don Rubio, director of the Engineering and Operations Department, and Vin Poeppelmeier, assistant to the president of INPO, took responsibility as principal communication links, and by year-end the instances of program overlap and technical misunderstanding had dropped to near zero. □

JUNE

First structural tests at TLMRF

EPRI's Transmission Line Mechanical Research Facility, conceived in 1979 and built in the past two years, began its program of cosponsored research with a steel pole designed and furnished by Oregon Iron Works. In addition to economies in materials and fabrication, data from the Haslet, Texas, facility will give precision and consistency to the computer-aided models that are used increasingly in tower and line design. □

JULY

Gas price supports for Cool Water

The first price guarantee agreement under the U.S. Synthetic Fuels Corp. program was executed in favor of the Cool Water demonstration power plant project. Up to $120 million will be paid by the federal government over a five-year period if electricity revenues to Southern California Edison Co. (at state-regulated rates) do not cover operating costs of the 100-MW plant. Being built under EPRI and other private industry auspices, the plant integrates a coal gasifier with combined-cycle power generating units. Startup is scheduled for May 1984. □

AUGUST

Board approves fluidized-bed funding

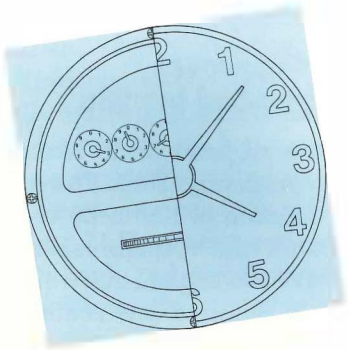
A joint proposal from Tennessee Valley Authority, Duke Power Co., and the state of Kentucky was selected for the cosponsorship of a 160-MW power plant that will demonstrate fluidized-bed combustion of coal for low SO_2 and NO_x emissions. EPRI's Board of Directors authorized a $75 million Institute share in the $220 million project. Construction is planned to begin in 1985, with startup of a three- to five-year test program in 1990. □

Superconducting generator project ends

Lessened utility industry interest and the priority of other R&D led EPRI to terminate development of a 270-MW superconducting generator. The four-year effort by Westinghouse Electric Corp. continued to be technically promising, although its cost had exceeded the original $19 million estimate and completion had been pushed to 1986. □

Rate Design Study in final phase

Meeting to review drafts of the latest reports prepared under Phase IV of the Electric Utility Rate Design Study, the project committee acknowledged that the nine-year effort would come to an end with publication of those reports early in 1984. The study stemmed from a 1974 resolution by the National Association of Regulatory Utility Com-



missioners that called on the utility industry to examine time-of-use electricity metering. A landmark in elaborating and analyzing methods of electricity costing and—especially—load management, the research has helped many utilities and regulators in the practical application of theoretical ratemaking concepts. □

Institute names new vice presidents

The directors of EPRI's six technical divisions were elected vice presidents, and Richard Balzhiser, head of the Research and Development Group, was named a senior vice president. Similarly, David Saxe became senior vice president of the Finance and Operations Group. Richard Rudman, director of the Information Services Group, was elected a vice president; and Milton Klein, formerly senior assistant to the president, was named vice president for Special Projects. In other actions at the same time, the Member Relations Department became a division, still directed by Joseph Prestele; and Henry Darius, EPRI's secretary, was named general counsel as well. □

SEPTEMBER

IR-100 awards recognize EPRI

Three developments sponsored by EPRI were among the 100 achievements honored by *Research and Development* in the magazine's annual competition. EPRI and Great Britain's Central Electricity Generating Board shared an award for the low-

oxidation-state metal ion (LOMI) process, which dissolves radioactive deposits inside nuclear reactor coolant piping. IR-100 awards also recognized Polysil, an insulator material developed with EPRI funding, and the Exxon Donor Solvent (EDS) process for coal liquefaction, developed and demonstrated with EPRI support. □

EPRI summaries to larger audience

Single-sheet summaries became EPRI's basic vehicle for announcing the more than 50 technical reports published each month. Targeted according to 92 variables of technology and subscriber interest, the new summaries are mailed to more than 4000 individuals. Complete reports continue to be distributed to the libraries of 250 utility, research, and government organizations. □

OCTOBER

Electrotechnology R&D begins

Electricity applications in the metal fabrication industries were designated for study under an EPRI-funded program at Battelle, Columbus Laboratories in Ohio. Energy efficiency and productivity of processes, equipment, and systems (including lasers and robotics) for heating, cutting, finishing, and assembly operations will be evaluated. EPRI's planned share in the initial three-year contract is about $160,000. □

NOVEMBER

Utilities to share cooling tests

Initially funded by EPRI and seven electric utilities, construction of a facility to assess cooling tower per-

formance got under way at a Houston Lighting & Power Co. generating plant. Conventional and advanced cooling modules will be compared in extensive thermal and hydraulic tests over a two-year period. Results will be used as the basis for utility purchase specifications and bid evaluation guidelines. □

Technology licensing takes hold

Completion of early research projects and the growing proportion of near-term R&D for utilities showed up in sharply higher figures for developments licensed by EPRI. Licensable computer software and data bases jumped from 30 packages in 1982 to more than 90 as 1983 neared its end, and a total of 85 finished products and processes had been catalogued as licensable inventions. Royalty income for the year was estimated to be $188,000. □

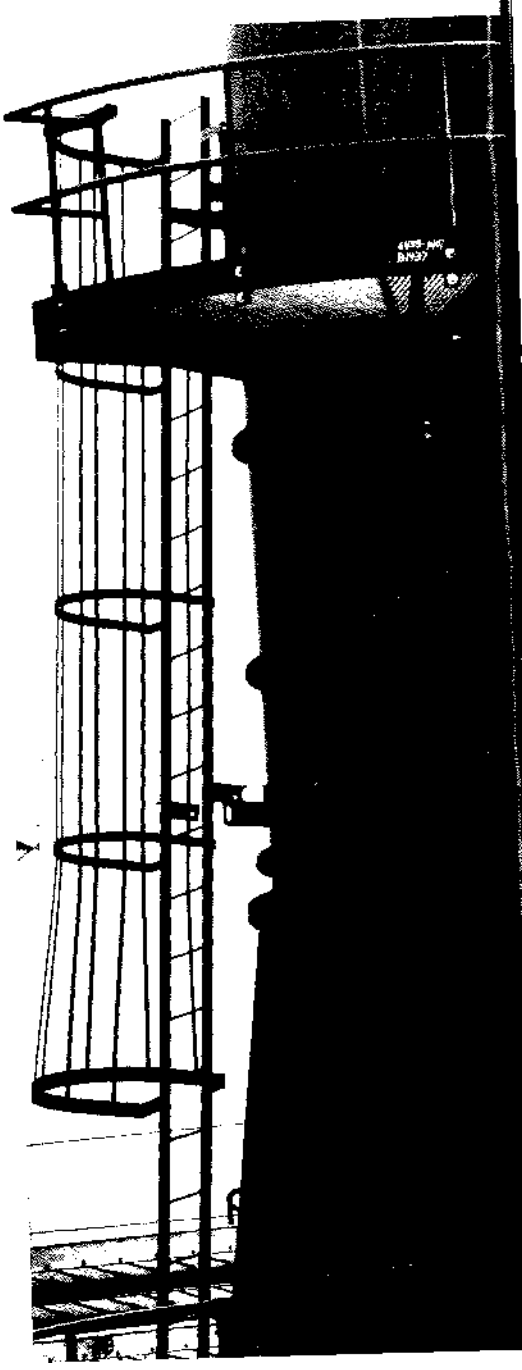
DECEMBER

Outlook for 1984

Institute expenditures for 1984 were budgeted at $341 million. The 4% increase over 1983 is expected to fall slightly below the rate of inflation. Revenues for the new year were estimated at $309 million. EPRI had 754 full-time employees at year-end, and only a few additions were expected in 1984. The 1983 staff (48 of them at facilities away from Palo Alto) included 359 technical professionals and 12 employees on loan from utilities and manufacturers. □

Meeting the Needs of the Utility Industry

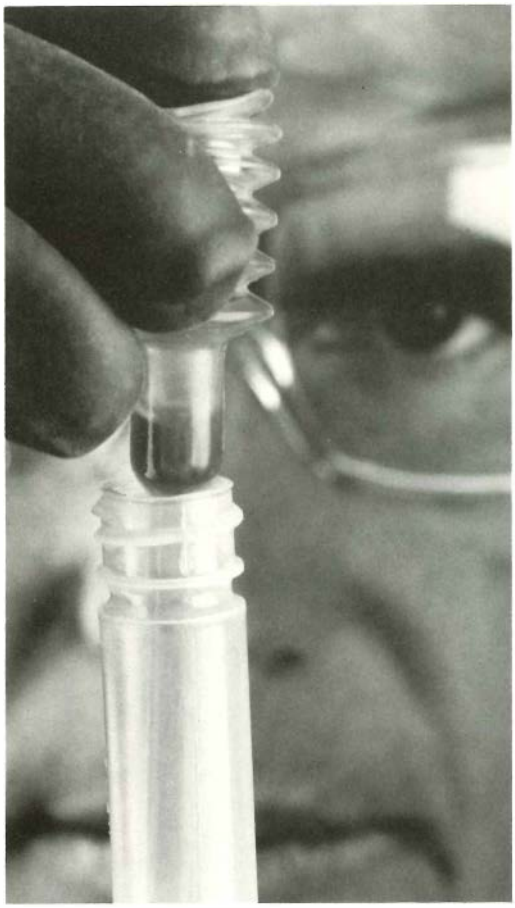
EPRI R&D Responses



Gasification—Combined Cycles

Clean Power From Coal

For coal to continue as a mainstay fuel for electric power generation amid environmental concerns, increased emphasis is needed on new technology to allow it to be burned cleanly and efficiently. One strong candidate is the gasification—combined-cycle (GCC) plant. With this technology, coal is chemically converted to gas, which is cooled, largely cleaned of pollutants, and then fired in a combustion turbine to produce electricity; by-product heat is exploited to make steam for generating still more power. An unprecedented partnership involving EPRI, industrial suppliers, contractors, process developers, and domestic and foreign utilities will culminate a five-year, $300 million cooperative R&D effort this summer with startup of a full-scale GCC power plant demonstration. The 100-MW plant, nearing completion at Southern California Edison Co.'s Cool Water generating station, will meet the nation's strictest emissions standards. Besides its environmental appeal, GCC technology promises the benefits of modularity, with shop fabrication of major components and shorter construction lead times, as well as high plant availability. (RP1459)



PCB Screening

On-Site Test for PCB Contamination

Utility transformers inadvertently contaminated with polychlorinated biphenyls (PCBs) are subject to rigorous handling and disposal regulations. But with some 20 million oil-filled transformers to screen for PCB contamination, utilities just can't afford slow, costly laboratory tests for each sample. Through a project with General Electric Co., EPRI has developed a pocket-size, disposable, low-cost test tube kit that can perform PCB tests in the field for as little as $4 a sample. The Clor-N-Oil PCB Screening Kit—two test tubes, premeasured reagents, and pipette—uses a color-forming reaction to show the presence of PCBs in transformer oil samples. By screening out samples with less than 50 ppm PCB, the kit eliminates the need for further testing in 50–70% of transformers, possibly saving the industry as much as $500 million. More than 100 utilities are now testing the Clor-N-Oil kits, available from EPRI licensee Dexsil Chemical Corp. (RP1713-1)*

*Clor-N-Oil is an EPRI trademark.

Acidic Deposition

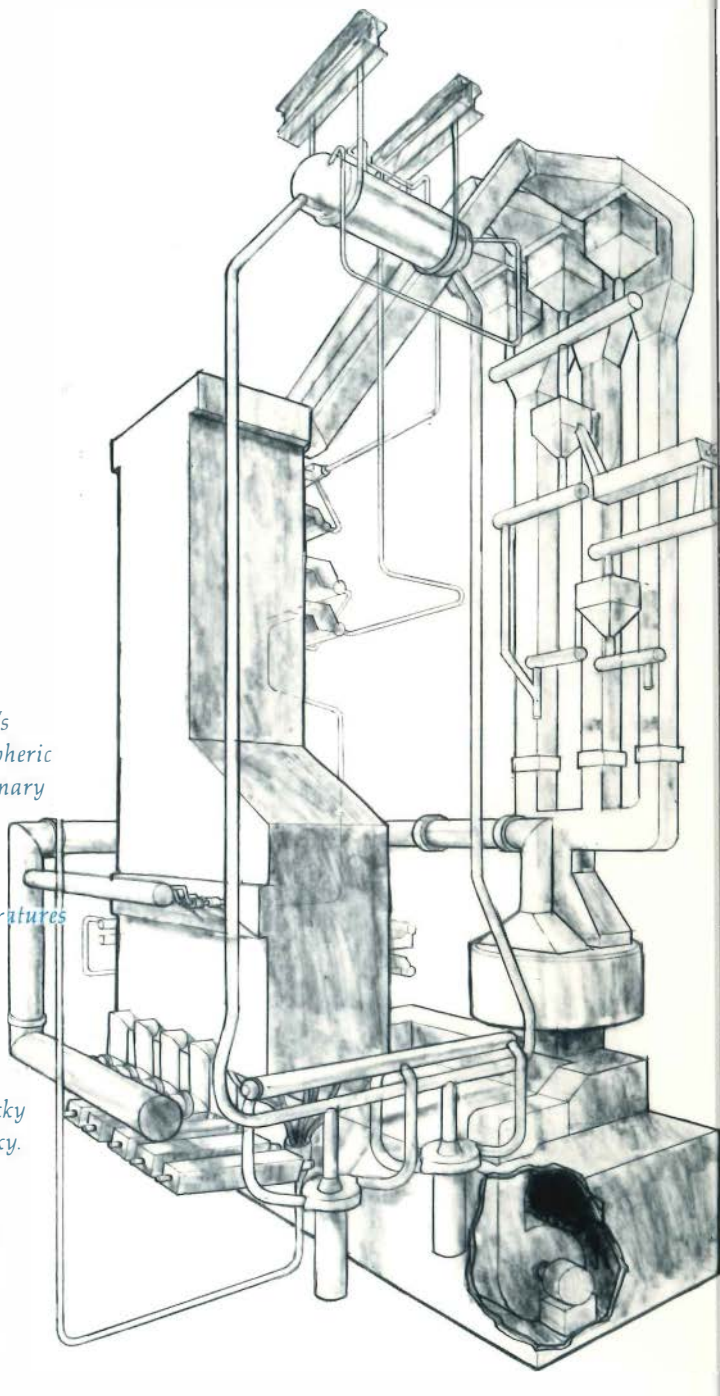
Deeper Understanding of Acid Rain

EPRI has become the electric utility industry's principal source of objective scientific and technical information on acidic deposition. The recently completed Sulfate Regional Experiment produced the most reliable data base available on atmospheric concentrations of sulfur oxides and other key pollutants in nonurban areas. In related projects, tracer experiments are following the paths of pollutants as they travel through the atmosphere, and research is documenting the wide variability over time and area in precipitation quality. On the terrestrial side, a lake watershed study focused on the interactions that influence the fate of acid compounds after they are deposited. The ADEPT model, an adaptation of decision analysis to the acid rain issue, is available to help decision makers evaluate future research needs, as well as control and mitigation strategies. (RP862, RP1109, RP2370)

Turbine Blades

Greater Steam Turbine Reliability

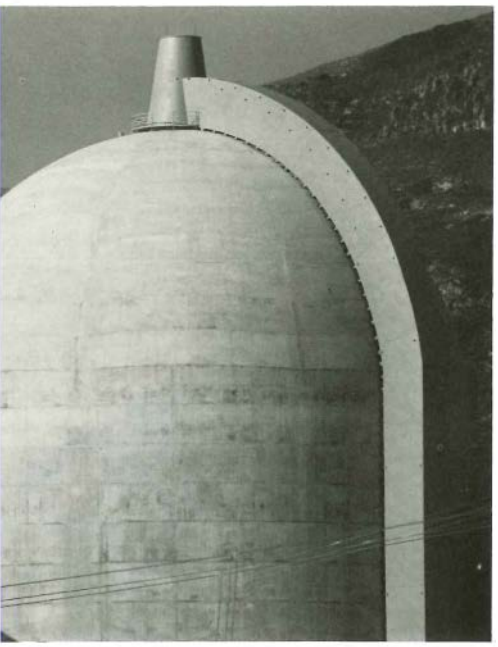
Steam turbine outages cost utilties over $300 million a year in repairs and replacement power. Most turbine outages are caused by blade failure—corrosive contaminants in steam concentrate on the blades and combine with fatigue stress to weaken blade materials by as much as 80%. An integrated, multidivision EPRI research program in steam turbine blading is looking at blade problems from a number of perspectives. Projects on the root causes of blade failures, development of improved tools for performance monitoring and failure diagnostics, and investigation of alternative blade materials form the core of the work, supplemented by studies of complex materials stress factors, which will contribute to improved blade design. Other projects focus on ways to minimize solid-particle erosion of surfaces in high- and intermediate-pressure turbines.



Fluidized-Bed Combustion

A Better Way to Burn Coal

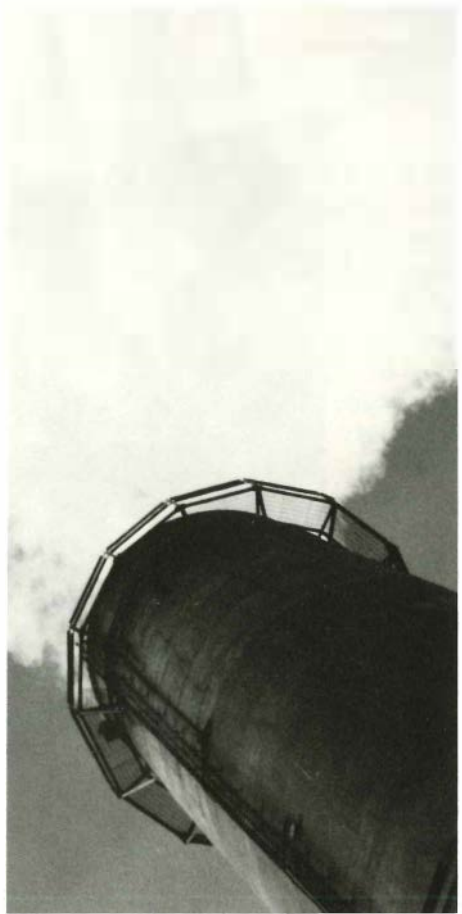
Today's coal-fired boilers are burdened with slagging and emissions problems, but tomorrow's boilers may neatly avoid these concerns. Atmospheric fluidized-bed combustion (AFBC) is an evolutionary boiler technology in which coal is burned at relatively low temperatures in a fluidized bed of limestone. The limestone absorbs the SO_2 formed during combustion, while the low temperatures reduce NO_x formation and eliminate slagging. Best of all, the AFBC boiler is nearly here: after years of testing at development and pilot facilities, AFBC is moving up to a full-scale, 160-MW demonstration cosponsored by EPRI, TVA, Duke Power Co., and the state of Kentucky at TVA's Shawnee station in Paducah, Kentucky. A boiler contract is expected to be awarded this fall; construction may start in early 1986. Operation and a four-year test program should begin in 1989. Northern States Power Co. and Colorado Ute Electric Association, Inc., are also planning full-scale AFBC demonstrations. By the 1990s utilities should have the basis to confidently buy AFBC boilers. (RP2543)



Source Term

Realistic Estimates of Reactor Accident Consequences

Realistic emergency response planning for a severe nuclear power plant accident implies having reliable, detailed knowledge of the potential for releases of radioactive fission products. But the Three Mile Island accident showed that actual release of fission products were about 1000 times lower than would be estimated by using current regulatory standards. EPRI, together with government and industry research groups in the United States and abroad, has sponsored a series of major technical studies of fission products released from damaged fuel and how these materials behave inside a reactor. The results are providing a sound technical basis for more-realistic estimates of the consequences of severe accidents and, in turn, more-rational planning for such events.



Air Quality

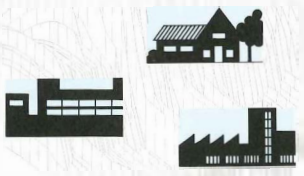
Accurate Data on Air Pollution

Public and political pressure for stricter emission control regulations continues to grow. In line with these concerns, EPRI sponsors many air quality studies aimed at obtaining accurate data on the sources and concentrations of pollutants. Results of EPRI's plume model validation study, for example, serve as a basis for evaluating the accuracy of models used in calculating pollutant concentrations within 30 miles (48 km) of a power plant—the figure currently used in determining permissible emissions. In other studies, research on levels of pollutant exposure to humans and ecological systems provides a foundation for evaluating environmental risk, an increasingly prominent aspect of Environmental Protection Agency policy. Important to both these areas is EPRI's work in developing methods to integrate data on all aspects of air quality and pollutant effects in a way that reflects both the certainties and the uncertainties implicit in our present knowledge. (RP1616, RP1630, RP1954)

Heat Pumps

Improving Heat Pump Performance

Over one-quarter of all new homes built today will be heated and cooled by an electric heat pump, a device that can warm indoor space by transferring outdoor heat indoors or cool indoor space by pumping heat outdoors. These devices have been available for years, but changing economics and technology have made them more attractive: today's heat pumps offer consumers clean, reliable, and cost-effective electric space and water heating, while providing utilities with a means of improving annual electric load factors. The goal of EPRI's heat pump research is to develop equipment that combines improved seasonal performance with more favorable utility load characteristics for both residential and commercial applications. EPRI and Carrier Corp. are now developing an advanced central heat pump for both residential and small commercial buildings. The objectives are to improve seasonal heating performance by 30%, match the cooling performance of top-rated air conditioners, and achieve demand reduction in both heating and cooling modes; technical feasibility of these goals was confirmed this past year. (RP2033-1)



Decision Making

New Tools for Utility Planning

Whether it is estimating electricity demand, planning new generation capacity, evaluating load management alternatives, or developing fuel purchasing strategies, a utility must always make decisions on the basis of incomplete information. EPRI-developed tools are helping to ensure that such decisions are the most rational possible, given many uncertainties. The load management strategy testing model, for example, gives utilities a technical basis for comparing costs and benefits of load management programs. The residential energy and load pattern forecasting model, originally developed for aggregating large amounts of end-use data in national forecasts, can now be applied by individual utilities to their service areas; another model produces similar forecasts for the commercial sector. And fuel supply planning, now a leading concern for many utilities, is the focus of several projects aimed at helping utilities design more-flexible fuel procurement and inventory strategies. (RP1215, RP1485, RP1918)

Arapahoe Test Facility

Advancing Emission Control Systems

Cleanup of combustion gases from fossil fuel plants can take many forms, from particulate control via baghouses and electrostatic precipitators to several variations on SO_2 scrubbing. The Arapahoe Test Facility, adjacent to Public Service Co. of Colorado's Arapahoe station near Denver, provides a unique environment for large-scale evaluation of these and other emission control technologies at an operating utility site. Eight interconnected pilot plants use exhaust gas from a 110-MW coal-fired boiler to test advanced concepts in environmental control of particulates, NO_x, and SO_2. The objectives are to reduce the complexity and overall costs of these systems, while improving their effectiveness and reliability. The research is also aimed at development of engineering design guidelines for integrated environmental control—a concept in which emission control subsystems are treated as integral elements of total plant design rather than as add-on devices. (RP1646, RP1959)

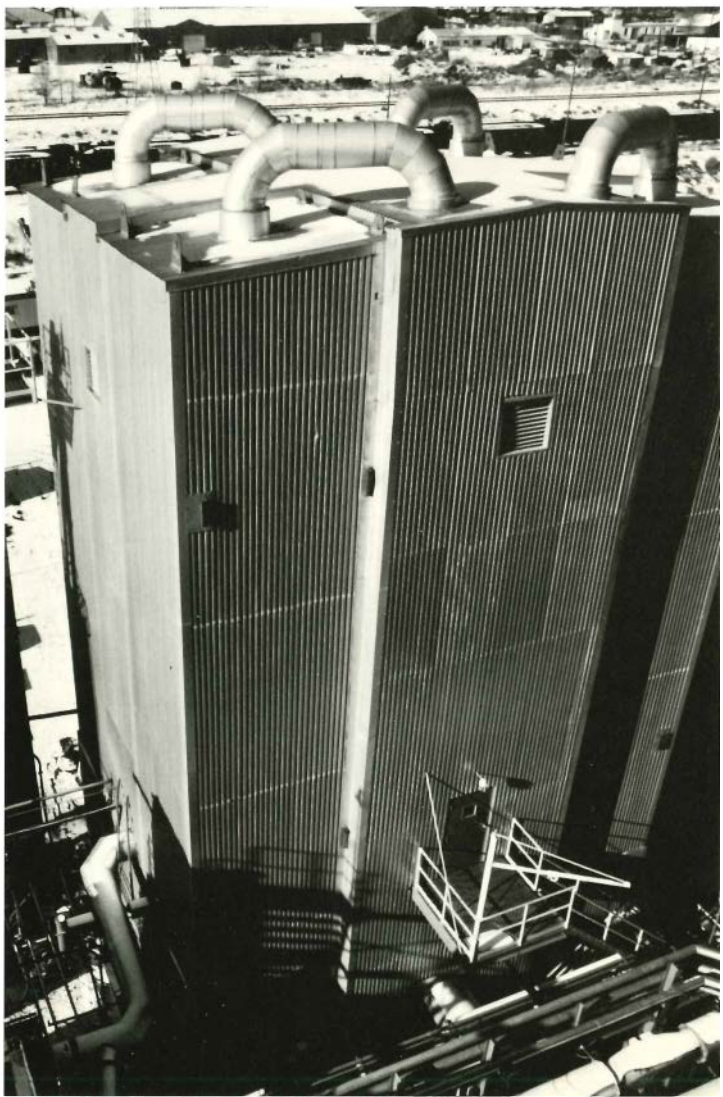
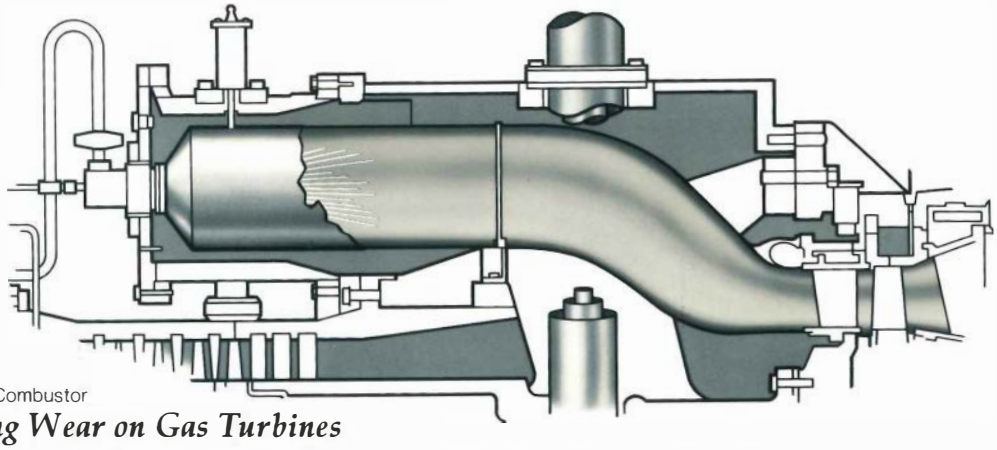


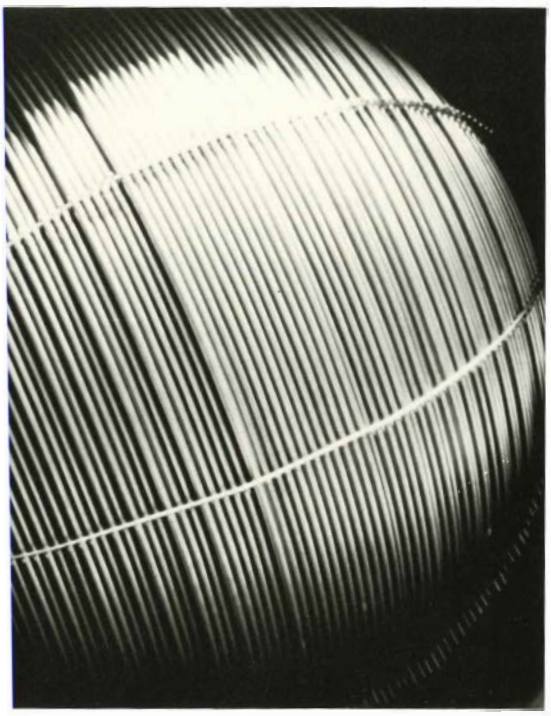
Photo courtesy Westinghouse Electric Corp.



Multinozzle Combustor

Reducing Wear on Gas Turbines

Gas turbines account for some 54,000 MW of generating capacity in the United States. To a great extent, improving the operating economics of these machines depends on reducing the frequency of inspections and repairs required. A project cosponsored by EPRI and General Electric Co. is approaching the problem through design and extensive testing of a prototype high-reliability gas turbine combustion system that could more than double the time between shutdowns for inspection of this type of machine. Accelerated combustion system wear is related to flame pulses in the combustion chamber that result from water injection to reduce NO_x emissions. The high-reliability system employs a turbine modified with a multinozzle combustor, which reduces flame pulses and the resultant noise and mechanical vibrations. The technology is suitable for new plants or for retrofit of existing machines. (RP1801)



PWR Corrosion

Guidelines for Water Chemistry Control

Without strict water chemistry control in pressurized water reactor secondary systems, corrosion problems in steam generators and turbines can easily escalate, ultimately leading to unscheduled shutdowns and reduced availability. Through an EPRI-coordinated effort the Steam Generator Owners Group has established how water chemistry can mitigate—or accelerate—the onset of corrosion problems and has developed guidelines for secondary-system water chemistry. These guidelines are now available to utilities in a special EPRI report (NP-2704-SR). The report details management responsibilities, as well as technical issues regarding recirculating and once-through steam generators, analytic methods, and data management and surveillance. Portland General Electric Co. has rigorously adhered to the new guidelines at its Trojan plant and estimates an O&M savings of at least $200 million over 10 years as a result.

Cable Follower

Minimizing Excavation for Underground Cables

Thanks to a new device being developed by EPRI and Flow Industries, Inc., old or failed underground distribution cable may be replaced with a minimum of costly, bothersome excavation and associated customer-relations problems. The cable follower uses the original cable as a guide for opening up a tunnel for the new cable. Workers identify a length of cable to be replaced, dig down to the cable at the start and finish of the run, and set the follower to work: the device's grippers hug the old cable, advancing on it while built-in water jets cut and remove soil ahead of and around the cable. When the follower finishes its underground run, the old cable is withdrawn from the tunnel and the new cable pulled in. The minimal excavation leaves gardens, lawns, sidewalks, driveways, and streets intact. Field tests on the cable follower will begin in spring 1984 and continue through the summer. (RP1287)

Cooling Buildings

Guide to Cool Storage Design

The cooling requirements of large commercial buildings can account for as much as 40% of a utility's peak demand on a hot summer day. Cool storage can shift some or all of this peak period cooling demand to off-peak periods. Utilities want to encourage design engineers to include cool storage in commercial buildings, but system selection, sizing, and cost and performance information is not readily available. In a cooperative effort with General Public Utilities Corp., EPRI has developed a guide to commercial cool storage design that substantially expands and updates a guide developed three years ago by Southern California Edison Co. The new guide (to be published this spring) addresses economic considerations, attractive system concepts, proper design and sizing, and practical operating strategies. EPRI is also assembling a seminar package for utilities that would like to present information on cool storage to consulting engineers in their service areas. (RP2036-3)

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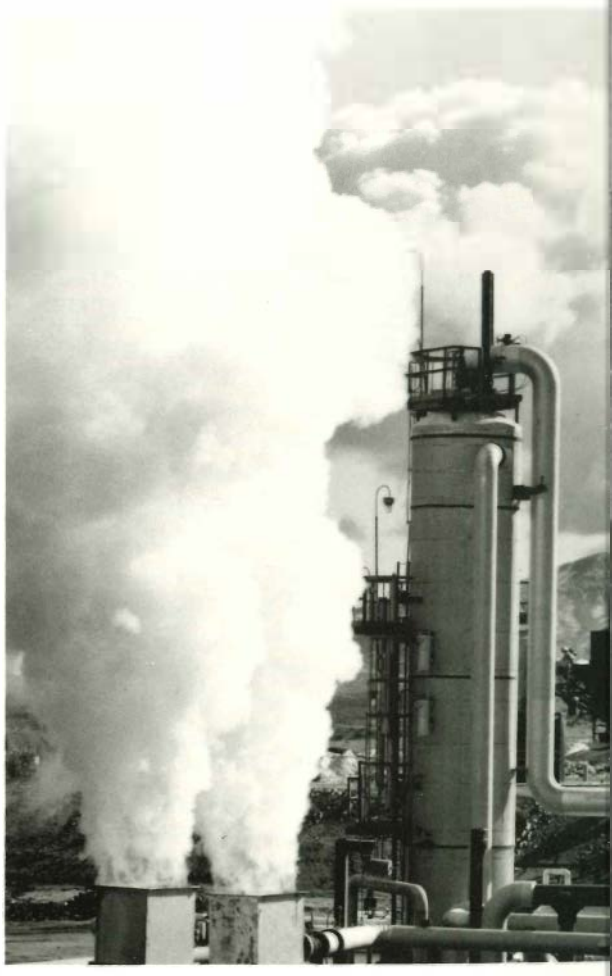
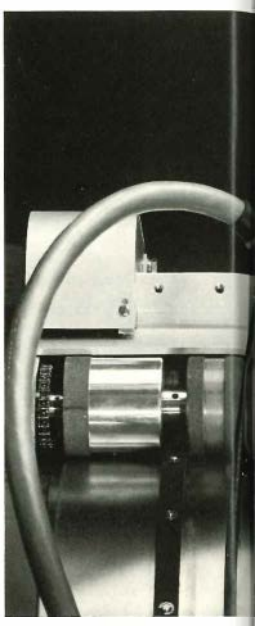
Rotary Separator–Turbine

Getting More From Geothermal Wells

Undeveloped geothermal resources are substantial, but their dispersed nature and varying thermal quality place a premium on generating efficiency. As a result, many new developments in coming years will involve power turbines at the wellhead in sizes up to about 10 MW. To improve the energy conversion efficiency of these machines, EPRI developed a rotary separator–turbine (RST) that allows utilities to tap moderate- to high-temperature hydrothermal reservoirs at a cost competitive with some conventional central station generating options. The RST is a specially designed hydraulic turbine—when coupled with a conventional steam turbine, it generates electricity both from kinetic energy in the liquid portion of the liquid-steam mixture as it passes through the RST and from the steam after the RST has separated it from the liquid. The result: more kilowatthours can be generated from geothermal fluids per dollar of capital investment. A $10 million cooperative effort with Utah Power & Light Co. and Biphase Energy Systems, Inc., logged over 4000 hours of endurance tests on the hydraulic turbine and advanced the RST concept from the experimental to the prototype stage in just over three years. Commercial units are under construction and may be in operation within two years. (RP1196)



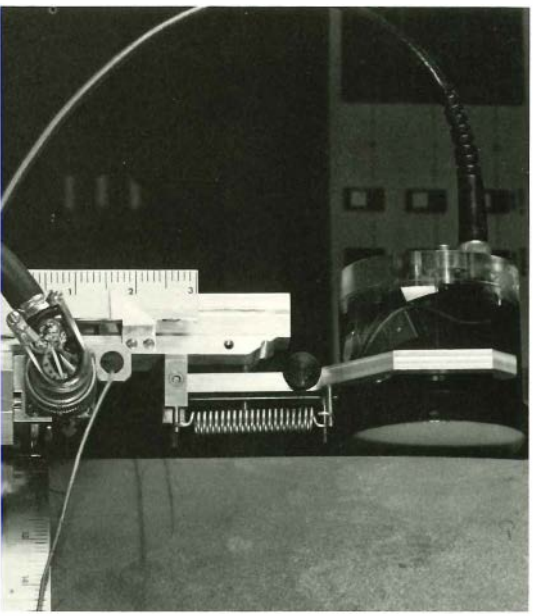


TLMRF

Cost-Effective Transmission Structure Design

Between now and the year 2000, electric utilities will install up to 100,000 miles (160,900 km) of new transmission lines at a staggering cost of nearly $30 billion. EPRI's new Transmission Line Mechanical Research Facility (TLMRF) will help ensure that this network is as cost-effective and reliable as possible. The 214-acre (86-ha) TLMRF, located near Fort Worth, Texas, is the world's most advanced facility for transmission system structural testing and research. TLMRF will test all types of transmission structures, poles, and foundations by simulating the stresses experienced in normal use. Results will validate and improve modeling techniques for predicting structure failures, establish compliance with specification requirements, and help develop new designs and materials. TLMRF tests are cosponsored by individual utilities or fabricators, and the knowledge gained will be available to the entire industry. (RP2016)

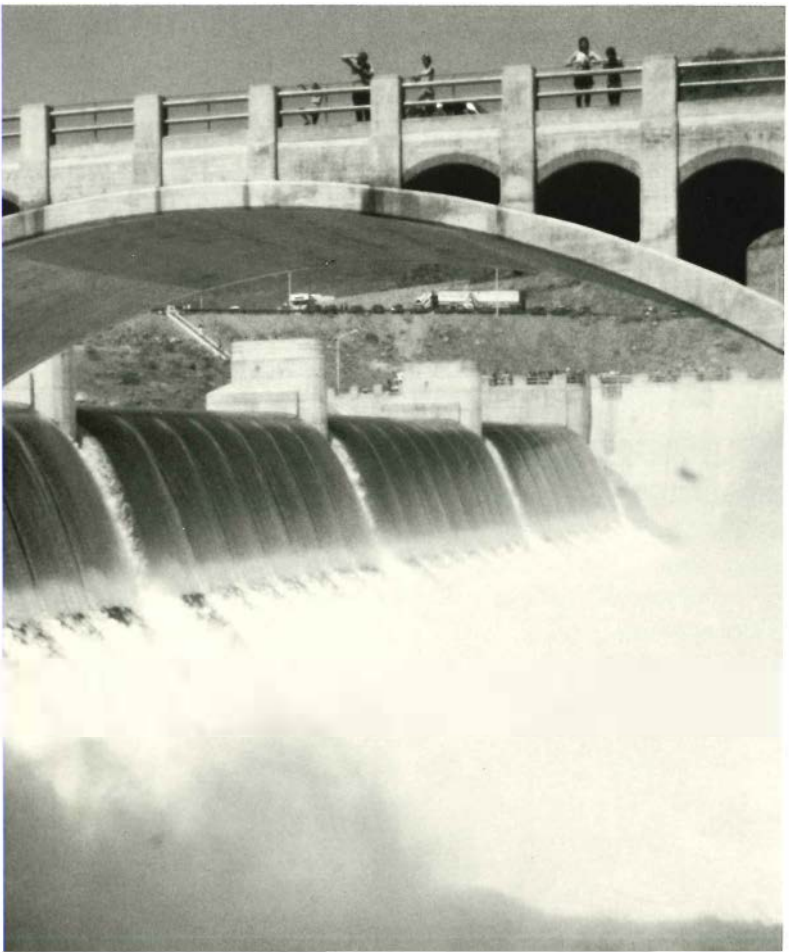
Photo courtesy Bureau of Reclamation.



Nondestructive Evaluation

Automated Inspection Systems for BWRs

The stainless steel recirculation pipes in boiling water reactors must be regularly inspected for signs of intergranular stress corrosion cracking. Conventional examinations rely heavily on the skill of individual inspectors, but new automated inspection systems can improve test reliability, while reducing worker radiation exposure. At EPRI's Nondestructive Evaluation (NDE) Center in Charlotte, North Carolina, two prototype ultrasonic inspection systems developed by the Institute have passed significant milestones. One system combines a conventional hand-scan approach with computer-assisted signal analysis. The second system combines a remote-control scanning sensor with the same signal analysis approach. Both systems have met all performance requirements set by the NRC. (RP1570-2)



Hydroelectric Power

Spreading the Word on Hydro Improvements

Hydroelectric generation is not only a major source of electricity in the United States but is also one of the utility industry's most reliable methods of producing power. Hydro is becoming even more reliable as individual power producers significantly reduce their forced and scheduled outages through innovative diagnostic or repair techniques. Still, little has been done to share technical information on progress within the industry. To make it easier for utilities to benefit from up-to-date information and techniques developed by others, EPRI recently sponsored two national operation and maintenance workshops, drawing representatives from over 100 hydropower producers. EPRI is also collaborating with an established magazine, Hydro Review, *to publish articles on the latest in hydro improvement techniques. Until now, this Boston-based quarterly has covered only small hydro, but with EPRI assistance it will expand its coverage to include large hydro as well. (RP1745-7)*

Generation Planning

An Integrated Model for Generation Expansion

Solid load forecasts, simple technology choices, and a stable business environment made it fairly easy for utility planners of the past to plan future electric generation systems. Today, things are not so straightforward: uncertain load growth, new technology options, and regulatory restrictions require computation methods that are more complex and flexible than those previously used. EPRI has developed a major new computer program that integrates three formerly separate analyses for greater speed and flexibility, using a common data base. The electric generation expansion analysis system (EGEAS) calculates what plants will be needed, projects a schedule for plant introduction, and identifies the lowest-cost alternatives. EGEAS was tested at six utilities and released in May 1983; some 60 utilities are now using the model, and a recently formed users' group boasts 100 members. (RP1529)

Report Distribution

Easier Access to Research Results

EPRI technical reports now number more than 4000, and as the volume of paper has grown, so has the challenge of ensuring that technical information reaches the appropriate individuals at member utilities. A data base system, implemented in 1983, allows the Institute to target distribution of research results to individuals who have indicated interest in specific research categories or technical fields. Each new report is announced via a one-page summary distributed according to the data base. Many readers will find all the information they need in a summary, but for those who want more, the summary sheet includes instructions on how to order the full report. A comprehensive bibliographic data base of EPRI reports, developed in cooperation with Arizona Public Service Co. and updated monthly, is also available to utilities for use on their own computer systems.

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)

	1983		1982	
	Base Program	Separately Funded Programs	Base Program	Separately Funded Programs
ASSETS				
Current assets:				
Cash and short-term marketable securities (Note 2)	$ 33,786	$10,726	$ 49,635	$17,937
Amounts due from members	4,209	1,127	16,866	971
Accrued interest receivable	276	–	320	77
Other current assets	3,356	11	3,935	24
	41,627	11,864	70,756	19,009
Property, facilities, and equipment (Note 3)	37,347	–	35,468	–
Funds held by trustee (Note 4)	4,920	–	2,555	–
Total assets	83,894	11,864	108,779	19,009
LIABILITIES				
Current liabilities:				
Research and development expenses payable	81,708	4,244	86,424	7,230
Accounts payable and other accrued liabilities	7,981	1,032	6,843	7,782
Current portion of long-term debt and obligations under capital lease (Notes 4 and 5)	1,889	–	1,742	–
Interest payable	626	–	86	–
	92,204	5,276	95,095	15,012
Long-term research and development expenses payable	1,158	7	1,321	65
Long-term debt (Note 4)	24,982	–	12,823	–
Obligations under capital lease (Note 5)	3,528	–	3,576	–
Total liabilities	121,872	5,283	112,815	15,077
Commitments (Notes 5 and 6)				
FUND BALANCE (DEFICIT)	$ (37,978)	$ 6,581	$ (4,036)	$ 3,932

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)

	1983		1982	
	Base Program	Separately Funded Programs	Base Program	Separately Funded Programs
REVENUES				
Industry payments (Note 11)	$284,672	$14,395	$281,743	$ 4,838
Interest income	4,998	1,198	7,609	2,804
Other income	2,981	11	2,297	97
Total revenues	292,651	15,604	291,649	7,739
EXPENSES				
Research and development (Note 9)	272,369	10,906	265,228	20,524
Program management	54,224	2,049	46,063	2,025
Total expenses	326,593	12,955	311,291	22,549
EXCESS (DEFICIENCY) OF REVENUES OVER EXPENSES	(33,942)	2,649	(19,642)	(14,810)
FUND BALANCE (DEFICIT), BEGINNING OF YEAR	(4,036)	3,932	15,606	18,742
FUND BALANCE (DEFICIT), END OF YEAR	$(37,978)	$ 6,581	$ (4,036)	$ 3,932

See accompanying notes to financial statements.

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

	1983		1982	
	Base Program	Separately Funded Programs	Base Program	Separately Funded Programs
Cash used by operations:				
Excess (deficiency) of revenues over expenses	$(33,942)	$ 2,649	$(19,642)	$(14,810)
Add (deduct) items not affecting cash in the period:				
Depreciation	2,799	–	1,864	–
Decrease (increase) in amounts due from members	12,657	(156)	6,853	1,095
Decrease (increase) in other current assets except cash and short-term marketable securities	623	90	(1,429)	133
Increase (decrease) in liabilities excluding debt and capital lease	(3,201)	(9,794)	8,772	7,233
Total	(21,064)	(7,211)	(3,582)	(6,349)
Cash was used for:				
Additions to property, facilities, and equipment	4,678	–	6,065	–
Payment of long-term debt	1,742	–	1,606	–
Total	6,420	–	7,671	–
Decrease in cash and short-term marketable securities before financing activities	(27,484)	(7,211)	(11,253)	(6,349)
Financing activities:				
Bond proceeds	14,000	–	–	–
Withdrawal from (deposit with) bond trustee	(2,365)	–	1,630	–
Decrease in cash and short-term marketable securities	$(15,849)	$(7,211)	$ (9,623)	$ (6,349)

See accompanying notes to financial statements.

Electric Power Research Institute, Inc.
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 nine separately funded research efforts. These are the Boiling Water Reactor Owners Group Intergranular Stress Corrosion Cracking Programs I and II (ISCCP), the Hydrogen Control Program (HCP), the Nuclear Fuel Industry Research Program (NFIRP), the Pressurized Water Reactor Safety and Relief Valve Program (RVP), the Seismicity Program (SP), the Steam Generator Owners Group Programs I and II (SGP), and the Utility Acid Precipitation Study Program (UAPSP). In former years the Nuclear Safety and Analysis Center was a separately funded program. Beginning in 1983 funds for the continuation of the work are provided through the Base Program. Financial statements for 1982 have been restated for comparability.

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 program management expenses as they are incurred.

Under some research contracts, the Institute agrees to reimburse its contractors for the cost of specialized equipment needed to perform the work. In such cases, it is the Institute's policy to retain title to such equipment and to charge to expense the cost thereof when such cost is invoiced by the contractor. At the conclusion of the contract, such 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 and land leaseholds for use in program management 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, and 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.

Program management expenses incurred by the Institute are allocated to all research activities, including work performed by the Institute for the separately funded programs.

NOTE 2—Cash and short-term marketable securities:

Cash and short-term marketable securities, at cost that approximates market, comprise the following.

	1983	1982
	(thousands of dollars)	
Cash	$ 395	$ 8,058
Bankers acceptances and certificates of deposit	13,903	13,095
Commercial paper	30,214	46,419
	$44,512	$67,572

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, 1984, members have committed $271,798,000 for 1984 cash disbursements. For 1984, 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 1983 or 1982.

NOTE 3—Property, facilities, and equipment:

	1983	1982
	(thousands of dollars)	
Buildings and land leases	$37,888	$26,386
Equipment and leasehold improvements	6,523	2,308
Construction in progress	—	11,039
	44,411	39,733
Accumulated depreciation and amortization	(7,064)	(4,265)
	$37,347	$35,468

In 1983 an R&D facility was completed at a total cost of $11,501,000 that will be used extensively for Institute research over the next 10 years. Included in construction in progress in 1982 is $9,264,000 for the facility. (See Note 4.)

NOTE 4—Long-term debt:

	1983	1982
	(thousands of dollars)	
Mortgage	$ 2,123	$ 2,156
Bonds	24,700	12,365
	26,823	14,521
Less current portion	(1,841)	(1,698)
	$24,982	$12,823

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, which was $193,000 in 1983 and $196,000 in 1982, has been included in program management expenses.

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 a $13,900,000 issue of tax-exempt Industrial Development Revenue Bonds issued by the Indiana County Industrial Development Authority (the Bonds), 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.

1984	$ 1,805,000
1985	1,960,000
1986	2,125,000
1987	2,305,000
1988	2,505,000
	$10,700,000

Total 1983 and 1982 interest costs for the Bonds were $966,000 and $1,089,000, respectively, and are 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 (see Note 3), to be used for research involving the testing of transmission lines. The facility was financed through the proceeds of a $14,000,000 issue of tax-exempt Industrial Development Revenue Bonds by the Haslet Industrial Development Authority. They are secured by an irrevocable letter of credit for 10 years from 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 1983 interest costs were $457,000 and are 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, 1983, $4,920,000, 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 $1,437,000 in 1983 and $1,329,000 in 1982.

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 (Obligations 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, 1983, were as follows.

	Capital lease	Operating leases	Total
		(thousands of dollars)	
1984	$ 336	$1,442	$ 1,778
1985	336	1,308	1,644
1986	336	1,181	1,517
1987	336	861	1,197
1988	336	481	817
Thereafter	6,576	963	7,539
	8,256	$6,236	$14,492
Less amount representing interest	(4,680)		
Present value of the minimum capital lease commitment	$3,576		

Interest cost on the capital lease is included in program management expenses and was $292,000 in 1983 and $295,000 in 1982.

The present value of the minimum capital lease commitment of $3,576,000 is included in the accompanying statement of financial position, as current and noncurrent obligations of $48,000 and $3,528,000, respectively.

NOTE 6—Research funding:

As the Institute identifies prospective research projects, the maximum amounts that may be expended on such projects are authorized and appropriations for them are approved 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 appropriations.

The funding for the Base Program research projects is summarized as follows.

	1983	1982
	(thousands of dollars)	
Cumulative research expenditures made through the prior year-end on contracts since inception	$1,452,318	$1,187,090
Research expenditures, current year	272,369	265,228
Unexpended contract commitments	15,561	22,179
Amounts expended or committed under contracts since inception	1,740,248	1,474,497
Amounts authorized, not committed or appropriated	800,321	666,375
Total amounts authorized since inception	$2,540,569	$2,140,872

In addition to the unexpended contract commitments at December 31, 1983, in late 1983 the Institute entered into additional commitments with certain contractors for reimbursement of their 1984 research costs in the amount of $80,900,000. Generally, the Institute has the right to cancel research and development contract commitments upon 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. This year, as in prior years, the Institute has no taxable income.

NOTE 8—Pension plans:

The Institute has one pension plan for its employees, a defined contribution plan. The defined contribution plan 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 $2,994,000 for 1983, compared with $2,618,000 for 1982.

NOTE 9—Research and development expenses:

Research and development expenses for the Base Program by division are as follows.

	1983	1982
	(thousands of dollars)	
Advanced Power Systems	$ 53,610	$ 56,139
Coal Combustion Systems	45,719	48,452
Electrical Systems	35,355	35,341
Energy Analysis and Environment	33,571	33,129
Energy Management and Utilization	31,969	24,095
Nuclear Power	69,641	66,583
Other divisions	2,504	1,489
	$272,369	$265,228

Nuclear Power Division's 1982 expense has been restated for 1982 to include $7,388,000 of the Nuclear Safety and Analysis Center. In-house research and development for 1982 of $5,952,000 previously included with program management expenses has been included with contract research and development.

NOTE 10—Separately funded programs:

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

	1983						1982
	ISCCP I	ISCCP II	SGP I	SGP II	Other	Total	Total
REVENUES							
Industry payments	$1,318	$ —	$1,064	$9,230	$2,783	$14,395	$ 4,838
Interest income	209	—	304	326	359	1,198	2,804
Other income	3	—	14	—	(6)	11	97
Total revenues	1,530	—	1,382	9,556	3,136	15,604	7,739
EXPENSES							
Research and development	3,984	1,322	1,112	3,102	1,386	10,906	20,524
Program management	413	—	338	1,075	223	2,049	2,025
Total expenses	4,397	1,322	1,450	4,177	1,609	12,955	22,549
EXCESS (DEFICIENCY) OF REVENUES OVER EXPENSES	(2,867)	(1,322)	(68)	5,379	1,527	2,649	(14,810)
FUND BALANCE, BEGINNING OF YEAR	2,888	—	500	—	544	3,932	18,742
FUND BALANCE (DEFICIT), END OF YEAR	$ 21	$(1,322)	$ 432	$5,379	$2,071	$ 6,581	$ 3,932

For purposes of comparability, the 1982 total excludes the Nuclear Safety and Analysis Center, which is included in the Base Program in 1983.

NOTE 11—Industry payments:

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

	1983		1982	
	Base Program	Separately Funded Programs	Base Program	Separately Funded Programs
U.S. electric utilities:				
Investor-owned corporations	$248,379	$ 9,984	$241,813	$2,340
Nonfederal government agencies	20,182	224	20,439	450
Federal government agencies	10,024	164	10,899	328
Cooperatives	6,087	80	6,672	159
Other sources	—	3,943	1,920	1,561
	$284,672	$14,395	$281,743	$4,838

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, 1983 and 1982, 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, 1983 and 1982, confirmation of cash and securities owned by correspondence with the depositaries.

Price Waterhouse

San Jose, California
March 5, 1984

ELECTRIC POWER RESEARCH INSTITUTE, INC.

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