Annual Research Review

ELECTRIC POWER RESEARCH INSTITUTE

EPRI JOURNAL

JANUARY/FEBRUARY 1980

SOLAR WATER-HEATING AND DATA-MONITORING SYSTEM • ASSESSMENT OF ENERGY POLICY MODELS • TRANSMISSION STATIC VAR SYSTEMS • AXIAL-FLOW HYDROCARBON TURBINE-GENERATOR SET • NUCLEAR WASTE MANAGEMENT STATUS • FUSION-DRIVEN TOKAMAK HYBRID REACTOR FOR MISSILE FUEL PRODUCTION • DYNAMIC ENERGY SYSTEM OPTIMIZATION MODEL • COST COMPONENTS OF HIGH-CAPACITY TRANSMISSION OPTIONS • SLUDGE DEWATERING FOR FGD PRODUCTS • PROBABILISTIC ACCIDENT ANALYSIS • CATALYST DEVELOPMENT FOR COAL LIQUEFACTION • RIGHT-OF-WAY ECOLOGICAL EFFECTS • HIGH-VOLTAGE PARTICLE INITIATED BREAKDOWN IN GAS-INSULATED SYSTEMS • COAL STRUCTURE AND COAL LIQUEFACTION • LARGE-POOL LMFBR DESIGN • OPTIMIZATION METHODOLOGY FOR WET-DRY COOLING • BIOFOULING CONTROL INVESTIGATIONS • IMPROVED TECHNIQUES FOR BURIED TRANSMISSION CABLES • COMBUSTION OF SRC-2 FUEL OIL • ACOUSTIC TECHNIQUES FOR MEASURING STRESS REGIONS IN MATERIALS • HEBER GEOTHERMAL DEMONSTRATION POWER PLANT • SOFTWARE TO CALCULATE GEOLOGIC PARAMETERS FOR COAL PRODUCTION COSTS • CYCLIC LOAD CAPABILITIES OF FOSSIL-STEAM GENERATING UNITS • METHODOLOGY TO INCORPORATE UNCERTAINTY INTO COST AND PERFORMANCE DATA • FUEL-CYCLE COST MINIMIZATION • CONTROL TECHNOLOGY • ASSESSING ECOSYSTEMS OF COOLING WATERS • INTERCONNECTED POWER SYSTEMS OPERATION AT BELOW NORMAL FREQUENCY • ZINC CHLORINE BATTERY FOR UTILITY APPLICATIONS • RETRAN ANALYSIS OF TURBINE TRIP TESTS • STATUS OF LARGE-SCALE WIND SYSTEMS • SYNTHESIS OF ECOLOGICAL INFORMATION FROM COOLING IMPOUNDMENTS • OVERHEAD AC TRANSMISSION LINES AND GAS TRANSMISSION PIPELINES • SODIUM-BETA ALUMINA SOLID ELECTROLYTES • OPERATED TECHNIQUES TO REDUCE RADIATION FIELDS IN LWRS DURING MAINTENANCE • INTEGRAL CELL SCALE-UP AND PERFORMANCE VERIFICATION • MODELING FUTURE POWER PLANT LOCATION PATTERNS • LONGITUDINAL LOADING TESTS ON A TRANSMISSION LINE • ALLOY DESIGN FOR LONG-TIME STABILITY • VOID FRACTION MONITORING SYSTEM • ELECTRIC UTILITY SOLAR ENERGY ACTIVITIES • CHEMICAL EFFECTS OF POWER PLANT COOLING WATERS • LIGHT-TRIGGERED THYRISTORS FOR POWER SYSTEMS • COMMERCIAL SOLAR-AUGMENTED HEAT PUMP SYSTEM • AIRBORNE PARTICULATE RELEASES FROM LWRS • FUEL CELL POWER PLANT INTEGRATED SYSTEMS EVALUATION • FORMATION OF ACID PRECIPITATION • EHV REACTOR/CAPACITOR SWITCH • ELECTROSTATIC PRECIPITATOR PLATE RAPPING AND RELIABILITY • URANIUM ISOTOPIC SEPARATION BY AERODYNAMIC METHODS • ENHANCING FUSION ENERGY DEVELOPMENT • ELECTRIC LOAD FORECASTING MODELS • TAPED CABLES AND FORCED COOLING • TOKAMAK REACTOR CODES • HUMAN FACTORS METHODS FOR NUCLEAR CONTROL ROOM DESIGN • SOLAR HEATING AND COOLING SYSTEMS CAPABILITIES • WORKER EXPOSURE TO HIGH VOLTAGE ELECTRIC FIELDS • POWER SYSTEMS PLANNING AND OPERATIONS • BIOMASS ENERGY AND TECHNOLOGY • FUEL CYCLE ACCIDENT RISK ASSESSMENT • SULFUR-TOLERANT COMPONENTS FOR FUEL CELLS • PATTERNS OF ENERGY USE BY ELECTRIC APPLIANCES • ROTATING ELECTRICAL MACHINERY • THERMAL ENERGY STORAGE SYSTEMS • FLOW FIELDS AROUND PWR STEAM GENERATOR TUBE SUPPORT PLATES • SODIUM-SULFUR BATTERY EVALUATION • IMPACT OF TRANSIT SYSTEMS ON ELECTRIC UTILITY LOADS AND ENERGY CONSUMPTION • IMPROVED MATERIALS FOR GENERATORS • FLUE GAS CLEANING WASTES • OUTAGE PLANNING AND MAINTENANCE MANAGEMENT • LIQUEFACTION BEHAVIOR OF COALS IN SRC-1 PROCESS • LARGE-SCALE ENERGY MODELS • SUPERCONDUCTING GENERATOR • PARTICLE MIGRATION VELOCITIES IN ELECTROSTATIC PRECIPITATORS • GENERALIZATION OF THE ARMP DEPLETION CAPABILITY • FUEL DELIVERY AND STORAGE ALTERNATIVES FOR FUEL CELLS • ATMOSPHERIC POLLUTION BY TRACE NITROGEN COMPOUNDS • AUTOMATED DISTRIBUTION SYSTEM • UPGRADING COAL LIQUIDS TO POWER GENERATION FUELS • NUCLEAR DATA PROBLEMS FOR THERMAL REACTOR APPLICATIONS • HIGH-TEMPERATURE CERAMIC HEAT EXCHANGER • SOURCE ASSESSMENT OF COAL CONVERSION FACILITIES • ADDITIVES TO INHIBIT TREE GROWTH IN SOLID EXTRUDED CABLE INSULATION • PRODUCING LIQUID FUELS FROM BIOMATERIALS • PRESSURE BOUNDARY TECHNOLOGY PROGRESS • MARKET POTENTIAL FOR ELECTROLYTIC HYDROGEN • ECONOMIC GEOLOGY OF URANIUM • CONTAMINATION DETECTOR FOR EXTRUDABLE DIELECTRICS • FLUIDIZED-BED COMBUSTOR AIR HEATER FOR GAS TURBINES • SEMIAUTOMATIC WELD CROWN CONTOURING EQUIPMENT • REHEAT STUDY AND CORROSION-EROSION TESTS AT COLBERT PILOT • URANIUM SOLUTION MINING COST MODEL • DISTRIBUTION DATA BASE DESIGN • FGD SLUDGE DISPOSAL • CENTRIFUGAL PUMP PERFORMANCE IN TWO-PHASE FLOW • WIND POWER PLANTS IN UTILITY SYSTEMS • GENERATION SYSTEM RELIABILITY ANALYSIS FOR FUTURE COST/BENEFIT STUDIES • TRANSIENT STABILITY STUDIES • NUCLEAR ASSAY OF COAL • DYNAMIC ANALYSIS OF LOOP-TYPE LMFBRS • COMBUSTION OF SRC-2 FUEL OIL • ECONOMIC ANALYSIS OF COAL SUPPLY • MIDTERM SIMULATION OF ELECTRIC POWER SYSTEMS • BATTERY ENERGY STORAGE TEST FACILITY • TRANSIENT FUEL ROD BEHAVIOR DURING DESIGN BASIS EVENTS • LIME FGD SYSTEM DATA BOOK • MULTIPLE POWER PLANT COOLING SYSTEM EFFECTS • POLYSIL MATERIAL SYSTEMS FOR ELECTRICAL APPLICATIONS • MINERAL MATTER IN COAL LIQUEFACTION RESIDUES • COAL DESIGN AND OPERATING DATA • WHARTON ANNUAL ENERGY MODEL • SELF-CONTAINED AND PIPE-TYPE CABLES • FILTRATION EQUIPMENT FOR COAL LIQUIDS • MECHANIZED PIPE WELDING • BIOLOGICAL EFFECTS OF HIGH-VOLTAGE ELECTRIC FIELDS • EMERGENCY OPERATING TEMPERATURES FOR EXTRUDED DIELECTRIC CABLES • MAGNETIC SEPARATION OF MINERAL MATTER FROM COAL LIQUIDS • LWR FUEL PERFORMANCE • MATHEMATICAL MODELS FOR ATMOSPHERIC POLLUTANTS • AC OVERHEAD LINES MECHANICAL DESIGN • HIGH-EFFICIENCY ADVANCED-FUEL FUSION REACTORS • TRANSIENT DEFORMATION PROPERTIES OF ZIRCOLOY • PLUME MODEL VALIDATION STUDIES • GAS-INSULATED SUBSTATIONS AND EQUIPMENT • EXTRUDED

EPRI JOURNAL is published by the
Electric Power Research Institute.

EPRI was founded in 1972 by the nation's electric utilities to develop and manage a technology program for improving electric power production, distribution, and utilization.

EPRI JOURNAL Staff and Contributors
Brent Barker, Editor
Ralph Whitaker, Feature Editor
Nadine Lihach, Feature Writer
Jenny Hopkinson, Feature Writer
David Dietrich, Technical Editor
Susan Yessne, Production Editor
Pauline Burnett, Copy Chief
Jim Norris, Illustrator
Marie Newman (Washington)
Barry Sulpor (Public Information)
Dan Van Atta (News Bureau)
John Kenton (Nuclear)

Graphics Consultant: Frank A. Rodriquez

Ray Schuster, Director
Communications Division

Address correspondence to:
Editor
EPRI JOURNAL
Electric Power Research Institute
P.O. Box 10412
Palo Alto, California 94303

Cover: 1979 saw continued progress across the spectrum of energy technologies designed to benefit both the utilities and the ratepayers.

About This Issue

Each year at this time the *EPRI Journal* departs from its conventional format and steps back to take stock—to see how EPRI's work over the past year has contributed to the broad mission of the Institute, to examine any fundamental changes in operation, and to assess recent technical achievements.

The main purpose of EPRI is to provide improved technologies that can meet the changing needs of existing power systems and to foster the development of advanced alternatives for expanding those systems, while minimizing capital and operating costs to the benefit of both utility and rate payer.

This is a formidable mission, one that over the years has required a delicate balancing between near-term and long-term research and between the constant vision of a carefully integrated set of research goals and a strategy sufficiently dynamic to respond to changing conditions and new and pressing priorities.

The broad supply issues that once dominated our energy debates about the long term are now spoken of more frequently in present tense. The future that once seemed distant is suddenly upon us, and the weight of EPRI's research is now centered on the near term, that is, on hardware and systems that can be delivered in the next decade.

This issue of the *Journal* surveys some of the key events of the past year that have accelerated this shift in research emphasis toward the near term; discusses the cooperative arrangement with the Department of Energy that allows EPRI a significant role in the longer-term, higher-risk areas of energy research; surveys progress on 24 significant research projects in light of the Institute's primary goals; and tries to put a dollar figure on a few of the recent achievements in EPRI-sponsored research.

Volume 5, Number 1
January/February 1980

by Floyd Culler

In *The Hinge of Fate,* Winston Churchill observed that there are special times when significant changes occur in the course of history. At these junctures, even a few apparently unrelated events redirect society's activities and reorder its plans for the future. We are surely passing through such a time. Many sobering events now call upon us for new understanding, new decisions, and redirection of our efforts. The future that we can build looks dramatically different from what it did just a few months or years ago. Ominously, energy resources figure ever more urgently in our choices.

Chaos in Iran and the threat of religious war centered there have signaled unequivocally that we must not depend on the Middle East for oil. Invasion of Afghanistan underscores that insecurity. Our economy is buffeted by the rising cost of imported oil and by the rising cost of applying the many lessons learned over the past 20 years about our resources, our environment, and ourselves. Where these costs have been caused by unnecessary regulation and delay, they are especially painful to incur.

Electric utilities sensed early in the 1970s that changes would soon be needed in the practices of energy production and the patterns of energy use. Integrated R&D was seen as the means to prepare for those changes and, indeed, to bring them about. R&D was also seen as a necessity for dealing with new social perceptions of energy impacts on the environment and on human health. EPRI was founded in 1972, and its programs were well under way by mid-1974.

When I arrived two years ago, the EPRI staff had already established a reputation for scientific excellence and objectivity. Many assessments and evaluations had been done, and a relatively broad program was beginning to advance the state of the art in several technologies. With this start we have been able to deliver useful results and initiate demonstrations of major advances that will form the basis for future capacity additions and improvements in utility operations. Several of the following examples are summarized elsewhere in these pages.

□ A nuclear fuel failure prediction model, now available through EPRI, has enabled Consumers Power Co. to attain a more rapid rise to power during startups at its Palisades nuclear unit. Estimated replacement power savings are $700,000 per startup.

□ Enhanced system safety and reduced costs have been achieved by Florida Power & Light Co.'s use of improved underground distribution cables that inhibit corrosion of the copper neutral. FP&L is now applying this technology to 400,000 ft of cable through Everglades National Park.

□ New filter fabrics have been evaluated to determine their effectiveness in collecting fly ash from large coal-fired power plants. When these tests proved successful, Colorado Ute Electric Association elected to install a baghouse on its new Craig-3 plant at an estimated saving of $23–$37/kW in capital cost.

□ EPRI and the Bonneville Power Administration sponsored research that resulted in publication of a new guidebook for the design of ultrahigh-voltage transmission circuits. The construction savings that utilities may realize by building such UHV lines run as much as $535,000 per mile.

Our R&D programs are also providing practical solutions to problems of electricity pricing, system load prediction, cracks in pipes and turbine disks, cheaper transmission towers, better switching systems, cheaper and more versatile insulators, and a wide variety of practical devices, processes, and evaluation methods. Such examples—and there are many more—represent only a small fraction of EPRI's partnerships in developments with individual utilities. The harvest of measurable benefits from the foresight of 1972 has started.

Even EPRI's current successes, however well reasoned in their flow from early plans, are not proving a match for the imperatives put on us by recent events. The energy future is unfolding more rapidly than foreseen; the pressure of new political, economic, and social forces is squeezing our array of energy options; and time is urging us toward those efforts that can most quickly add muscle to existing technologies. Our R&D regimen is indeed becoming a crash diet, and the results closest at hand must be carried into early demonstration and commercialization if utilities are to attain the strength they need in this new decade.

Initially, the EPRI program was focused on R&D to develop long-term options for new generation and transmission technology, supply systems to support them, knowledge of the deleterious side effects of electricity production and use, and protective systems to reduce those effects. This program now includes elements to meet earlier needs of the industry. Much of our program, in fact, is focused on solving near-term problems so that today's plants keep on operating with significantly improved performance and reliability. Some 50–60% of the EPRI effort now has the objective of payoff over the next 10 years. Included are 22 research, development, test, and evaluation facilities, with 5 more scheduled under the next five-year program plan. Examples are three alternative systems for scrubbing flue gases at approximately 100-MW scale, an experimental coal-cleaning test facility with General Public Utilities Corp. and New York State Electric & Gas Corp., and a Texaco coal gasification and combined-cycle demonstration with Southern California Edison Co., Inc.

EPRI's trained staff also constitutes a major resource that can be mobilized to meet outright crisis. The immediate role of Institute staff members at Three Mile Island was a case in point, followed by cooperation in forming the Nuclear Safety Analysis Center and helping to establish the Institute for Nuclear Power Operations. Less urgent but equally topical occasions have seen us respond as best we can with knowledge about acid rain, about the effects of high voltage on living systems, about the steam generator problems of pressurized water reactor plants, and about stress corrosion cracking in boiling water reactor piping.

Intermediate-term R&D constitutes approximately 30–45% of our effort. Here the objective is to adapt to new fuel resource patterns (indeed, to further their development for utility use) and to provide new systems for meeting environmental requirements during the next 10–25 years.

Finally, we devote 5–10% of our funding to programs whose payoff may be more than 25 years hence, but which need to be initiated now. Although this proportion is small (or, perhaps, because of it), formulation of long-term R&D plans is at least as knotty a problem as it is for the acknowledged needs of this century.

Shifting Mandates

Federal law and research policies are fundamental expressions of the nation's energy policy and requirements for the future. Accordingly, shifts in EPRI strategy have also resulted from changes in federal research programs and new legislation affecting utilities. Over the past seven years, EPRI has cosponsored more than 50 projects with the federal government, thus helping to ensure continuity and providing utility input in government programs. Federal mandates have directly affected many EPRI programs, including coal cleaning, air quality control, desulfurization processes, water quality control, environmental assessment, water reactor systems technology, and utility rate design. How all these changes in research emphasis will help utilities meet the challenges of the 1980s can best be seen by examining several of EPRI's major program areas and how they are evolving.

[illegible]

EPRI's work in environmental research provides balanced information to regulators at both federal and state levels. It contributes to regulation that is based on science rather than emotion. For example, our analysis of the basis used for studies made in the early 1970s shows no statistical correlation between airborne sulfur oxide (or sulfate) concentrations and human health. These findings have not caused sulfur emission standards to be relaxed, but they have helped to slow the course of further restrictions. Oxides of both sulfur and nitrogen are, nevertheless, clearly implicated in the phenomenon of acid rain. Though the complex mechanisms and patterns of its occurrence are not yet understood, early results suggest that direct emission controls may not be a very successful way of addressing it. The demand for data on the effects of such environmental pollutants is fierce, but we simply cannot fund all the projects that clearly deserve attention.

Efficient generation and end-use practices are essential in the U.S. energy future, and utility roles are being mandated by law. EPRI programs on load management, solar energy conversion, energy storage, and electric vehicles are aimed at increasing efficiency. As are most of our sponsoring utilities, we are also extending our attention to the end-use side of the meter.

The clearest conservation opportunity is to reduce consumption of oil and to produce synthetic gas and liquids from coal and shale. EPRI is a cosponsor of a half-dozen coal-based synfuel projects that are now reaching the pilot plant stage, and by the end of the 1980s, when the Fuel Use Act prohibits utility use of petroleum liquids, several of these processes will be commercially available. Indeed, one of them—gasification with combined cycles—is now under contract for commercial-scale demonstration. Our studies and those of our contractors independently indicate that such a facility should be more fuel-efficient, require 40% less water than conventional coal-fired plants, and produce less solid and liquid effluents than other coal-based generation technology. General Electric Co. and Westinghouse Electric Corp. agree with us that combined cycles fueled by synthetic gas should generate electricity at costs competitive with those from steam cycles fueled by pulverized coal and equipped with contemporary emission controls.

EPRI has been deeply involved in nuclear technology development. This experience enabled us to help the utility industry respond quickly after Three Mile Island. The Nuclear Safety Analysis Center at EPRI has since analyzed the accident and in only six months, documented it thoroughly for the industry, a congressional hearing, and the Kemeny Commission. NSAC has now gone on with work designed to raise the level of technical and system capabilities of nuclear plants.

These functions will continue. NSAC will be concerned with the equipment, instrumentation, and technical aspects of nuclear plant design for safety and reliability. It will screen reports of incidents in nuclear stations and alert utilities to potential safety problems, working closely with the Institute for Nuclear Power Operations and other groups to ensure that nuclear power is safe and that it continues to remain a viable power option.

Pressing short-term demands tend to diminish attention to more fundamental and exploratory research. Indeed, EPRI's primary task is to translate basic research from the laboratory to the utility network. But to maintain balance, we must constantly reassess needs for exploratory R&D. Working with the industry's advisory committees, our staff has chosen promising new technologies for further development. Again, a few examples. EPRI is helping to develop a solar-thermal electric pilot plant, funding a fuel cell demonstration and encouraging a new users group, sponsoring research on high-efficiency photovoltaic systems, working to bring hydrothermal energy resources on-line, and assessing the requirement for fusion power plants. Such new technologies will offer utilities greater flexibility in meeting electricity demands with a variety of primary energy sources in the 1990s and beyond.

But even with constant reassessment of needs, the demand for R&D funds exceeds our ability to provide support. Each year, with the counsel of our advisory structure and the approval of our Board, we winnow a carefully selected program from the list of needs seen by utility task forces. Still, the program is likely to carry a price beyond our means. During the operating year we prune down, adjust, and eventually eliminate some projects, not only to balance the budget but also to accommodate the inevitable emergencies or exciting new research opportunities. This results in a tightly reasoned program that meets only the pressing needs of the industry.

Thus, it is possible to manage resources prudently, to produce beneficial results without waste. We have effective budget and expenditure controls, devoting as much as possible of EPRI's funds to R&D support and keeping our management costs as low as possible. For the past four years, EPRI's combined administrative and program management costs have averaged only 13.3% of the budget, a figure that is less than for most institutions similar to EPRI.

[illegible]

EPRI's most successful development is of little value if it isn't used. Neither near- nor long-term technological advances will produce benefits if there is no communication between the Institute and its sponsoring member utilities. One of the greatest challenges to R&D organizations is to speed the widespread application of favorable results. To this end, EPRI issues hundreds of reports each year. There are other approaches: workshops, meetings, articles, and the *EPRI Journal.* But we are sure that some vital development will be missed simply because it winds up three inches from the bottom of a two-foot stack of reports.

Some utilities have reported success in establishing specific coordinators or technical groups to receive and evaluate EPRI reports and the executive summaries. For our part, we are beginning this year to issue a quarterly *EPRI Guide,* which lists all available materials: reports, summaries, articles, films, slides, videotapes, brochures, computer programs, data bases, patents, and speeches. This problem of technology transfer has no easy solution, and we will continue to try different ways of disseminating our research results.

The future is indeed closer than ever. It is as close as our joint determination to formulate and fund the needed R&D, to perform and manage it, and then to monitor, evaluate, and apply the results as they are presented.

Highlights of 1979

EPRI's research directions and accomplishments for the next several years will be influenced by these administrative actions, management changes, and advisory appointments that were highlights of the Institute's 1979 operations.

JANUARY

Institute reduces carryover funds

At the beginning of its seventh year of utility industry service (1979), EPRI had carryover funds of $76 million, reserves of $19 million, and projected revenues of $192 million, a total close to that available in 1978. But the 1979 forecast for R&D and operations expenditures was $240 million, sharply above 1978. As 1979 unfolded, EPRI's performance closely tracked its forecast of contract activity, and by year-end the R&D carryover dropped to about $28 million.

Study center builds staff

Sam Schurr, who established EPRI's Energy Analysis and Environment Division in 1974, rejoined the Institute as deputy director of the Energy Study Center headed by Vice Chairman Chauncey Starr. Since leaving EPRI three years ago and for 20 years before 1974, Schurr was a research director with Resources for the Future, Inc. Later in 1979 he was joined by Milton Searl, former manager of the Supply Program in EPRI's Energy Analysis Department.

SCHURR

Research advisers named

Six industry executives were named to three-year terms on EPRI's Research Advisory Committee, chaired by Ellis T. Cox of Potomac Electric Power Co. During the year, two more replaced retiring RAC members, and two chairmen of EPRI division advisory committees were added. The 10 appointees in 1979 were Al Arenal of Southern California Edison Co.; Shepard Bartnoff of Jersey Central Power & Light Co.; Robert Bell of Consolidated Edison Co. of New York, Inc.; Joan Bok of New England Electric System; Sol Burstein of Wisconsin Electric Power Co.; Nolan Daines of Pacific Gas and Electric Co.; Granville Haven of Union Electric Co.; John Kauffman of Pennsylvania Power & Light Co.; Lee Turner, Jr., of Texas Utilities Co.; and J. Frederick Weinhold of the Tennessee Valley Authority.

FEBRUARY

Boost for clean coal research

Homer City, Pennsylvania, was selected as the site of a facility to test various means of cleaning raw coal. Joining EPRI in sponsorship were the site owners, Pennsylvania Electric Co. and New York State Electric & Gas Corp., and the Empire State Electric Energy Research Corp. Later in 1979 EPRI's Board of Directors authorized more than $12 million for the facility and its first two years of operation. Site preparation began in October, and R&D demonstrations are expected to start in June 1981.

TVA's Freeman joins Board

S. David Freeman, board chairman of the Tennessee Valley Authority, was appointed to serve on EPRI's Board of Directors, succeeding TVA's retired chairman, Aubrey Wagner. Before appointment to the TVA board in 1978, Freeman was on the White House energy advisory staff.

FREEMAN

MARCH

EPRI and DOE clarify roles

Cooperation in energy research, development, and demonstration was formalized by EPRI and the Department of Energy with the execution of an agreement covering technical information exchanges, joint project funding, and coordinated contracting. Building on the precedent of EPRI's earlier understandings with AEC and ERDA, the new agreement established bases for EPRI and DOE to cosponsor demonstrations of technologies involving $10 million or more that are nearing commercial readiness. The essential points are that DOE holds major contracting responsibility on joint projects, that EPRI participation covers at least 35% of the total estimated cost, and that EPRI has a substantial role in project management.

Technical exchanges expanded

Brazil's Centro de Pesquisas de Energia Eléctrica became the tenth foreign institute or government agency with which EPRI has agreed to exchange R&D information on electric power technology. Similar agreements were signed with Mexico's Instituto de Investigaciones Eléctricas in April and with Italy's Ente Nazionale per l'Energía Elléttrica in June.

Washington office moves

EPRI's Washington, D.C., office staff, headed by Robert Loftness, moved into new quarters at 1800 Massachusetts Avenue N.W. Featuring better conference facilities, the new offices quickly became a convenient center for many periodic meetings of EPRI advisory committees, task forces, and project review groups.

APRIL

Conference examines technology values

The Edison Centennial Symposium drew scientists, engineers, industrialists, academicians, and students to a three-day EPRI-organized agenda with the theme "Science, Technology, and the Human Prospect." Five general sessions featured 13 major speakers presenting theme issues and personal viewpoints, and seven workshop sessions elicited questions, answers, and discussion among symposium participants. The program was cosponsored by the Thomas Alva Edison Foundation as a major event of the electric power industry's centennial celebration of the first incandescent lamp.

Nuclear accident analysis begins

Responding to a utility industry request after the Three Mile Island nuclear plant accident, EPRI formed the Nuclear Safety Analysis Center (NSAC) to compile and study the accident record and recommend technical steps toward safer plant operation. Quickly staffed with EPRI researchers and professionals from utilities, universities, and the power industry, NSAC was placed under the direction of Edwin Zebroski, previously head of EPRI's Nuclear Systems and Materials Department. With a 1979 budget of $3.5 million, the center issued a complete accident sequence report in July; began detailed analysis of the causes and effects, the lessons learned, and the remedies that can be used to prevent or mitigate such events; and contributed to health effects studies undertaken by Pennsylvania and federal agencies.

MAY

Institute elects directors

Floyd W. Lewis of Middle South Utilities, Inc., was elected chairman of EPRI, succeeding Frank M. Warren of Portland General Electric Co. In other action at the annual meetings of EPRI's members and Board of Directors, six directors were elected or reelected to four-year terms: T. Louis Austin, Jr., of Texas Utilities Co.; S. David Freeman of the Tennessee Valley Authority; Arthur Hauspurg of Consolidated Edison Co. of New York, Inc.; Marshall McDonald of Florida Power & Light Co.; Guy Nichols of New England Electric System; and Barton Shackelford of Pacific Gas and Electric Co.


LEWIS

NDE methods under study

A new kind of research facility was announced as EPRI began detailed planning of a nondestructive evaluation (NDE) center. By October, J. A. Jones Applied Research Co. was named to organize and operate the facility at Charlotte, North Carolina, and $20 million was budgeted for the first five years of operation. The center will evaluate various NDE techniques used to verify the structural integrity of large power plant components. With a staff of 30 and an equal number of utility employees in training, it will also translate research into practical field procedures, train inspection personnel, and encourage academic involvement in NDE technology.

Advisory Council adds members

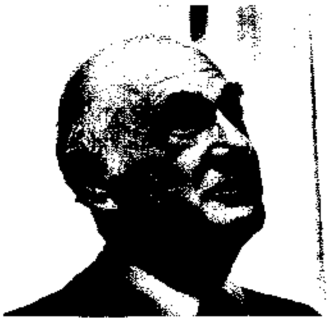
Six men with various interests and expertise outside the utility industry were appointed to three-year terms on EPRI's Advisory Council, and a seventh was named to replace a retiring member later in the year. In addition to Charles C. Coutant, manager of the power plant effects program at Oak Ridge National Laboratory, who was reelected for one year to serve as chairman, the new council members are Elie Abel, professor of communications at Stanford University; F. Kenneth Hare, provost of Trinity College in Toronto; Edward Mason, vice president for research with Standard Oil Co. (Indiana); Kenneth Randall, president of The Conference Board; John Sawhill, president of New York University; Irwin Stelzer, president of National Economic Research Associates, Inc.; and Stanley York, chairman of the Wisconsin Public Service Commission. Sawhill resigned in the fall when he was named deputy secretary of the Department of Energy.

JUNE

Environmental research director dies

Cyril Comar, director of EPRI's Environmental Assessment Department since early 1975, died on

June 11. Most recently recognized for his work on the environmental impacts of utility operations, the emeritus professor of Cornell University was the first chairman of the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation. His specialization in this field dates back to the 1940s, when he used radioisotopes in biological research. Testimony prepared by Comar on the implications of low-level radiation risk estimates for nuclear energy was delivered to a congressional committee shortly after his death.


COMAR

Setting nuclear operating benchmarks

The Institute for Nuclear Power Operations (INPO) began to take shape in recommendations announced by power industry committees established after Three Mile Island. Basic objectives for the independent institute were seen as setting benchmarks for nuclear reactor operation, evaluating performance of INPO member utilities against those benchmarks, establishing reactor operator training requirements, accrediting training programs, and certifying instructors. Organizational plans were shaped under the guidance of EPRI Vice Chairman Chauncey Starr, and in October William Lee, president of Duke Power Co., was named INPO chairman. To be located in Atlanta, Georgia, INPO is expected to be functional in January 1980, building toward a staff of about 200 and an annual budget of about $11 million.

JULY

Washington office adds deputy

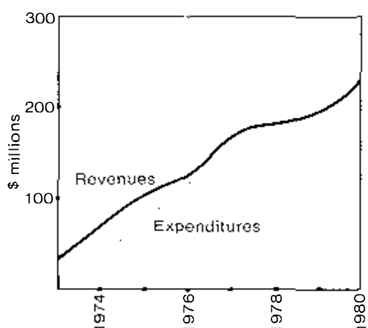
Robert Ritzmann was named deputy director of EPRI's Washington, D.C., staff headed by Robert Loftness. Previously an assistant director in the Department of Energy office of intergovernmental affairs, Ritzmann had been with DOE, ERDA, and AEC for 22 years.


RITZMANN

AUGUST

Board sets 1980 revenues

The assessment rate for EPRI member payments in 1980 was established at 0.22 mill per kilowatthour (based on each utility's 1978 electricity sales), up 14% from the 1979 rate. Based on a membership that accounts for over 70% of the electricity sold in the United States, the assessment was planned to produce $226 million in 1980 revenue. Combined with interest income, carryover funds, and reduction of the contingency reserve, this will fund 1980 research and operations at a forecast level of $276 million and leave a $10 million contingency reserve at the end of 1980.



Enlarged safety studies outlined

Charged with responsibility for program guidance to the Nuclear Safety Analysis Center (NSAC), a special seven-member subgroup of EPRI's Research Advisory Committee (RAC) completed its recommendations for NSAC's work in 1980. Endorsed by the TMI Ad Hoc Nuclear Oversight Committee, coordinating body for industry activities since Three Mile Island, the RAC subcommittee report tallied 12 program areas, proposed a 1980 research management budget of $7.5 million (requiring a staff of about 50), and acknowledged that some NSAC functions should be continued indefinitely. Building beyond analysis of TMI events alone, the NSAC program scope includes technical response to lessons learned from TMI, continued learning from other plant operating events, study of how to resolve generic safety issues, and "what if" studies to establish safety margins even if core melting should occur.

Building plans get green light

Five new buildings totaling 106,000 sq ft were authorized for EPRI's headquarters at Palo Alto. The $8 million project (to be sold and leased back) will complete development of the site, bring all EPRI operations together again by spring of 1981, and provide about 36,000 sq ft of space for initial sublease to others. The Electrical Systems Division and several administrative groups are now in rented quarters elsewhere in Palo Alto. With site work to begin by the end of 1979, award of the main construction contract is planned for early 1980.

SEPTEMBER

Department directors named

James L. Plummer became director of Energy Analysis in the Energy Analysis and Environment Division and Don Rubio became director of Engineering and Operations in the Nuclear Power Division. Plummer, an economist and one-time manager of energy studies for the National Science Foundation, had most recently been director of cor-


PLUMMER RUBIO

porate economics for Occidental Petroleum Corp. Don Rubio came to EPRI after 28 years with General Electric Co., the last 8 years as manager of the reactor design engineering section and then general manager of the reactor control and instrumentation department at San Jose, California.

OCTOBER

Conference focuses on particulates

More than 120 utility registrants participated in an EPRI-sponsored conference on the particulate matter emitted by fossil-fueled power plants. Directors and research managers from three Institute divisions, Coal Combustion Systems, Energy Analysis and Environment, and Advanced Power Systems, shared the platform as speakers and panelists to review the physics and chemistry, environmental effects, and control and disposal of particulates and to summarize research directions. Utility industry advisers to EPRI chaired the conference sessions, which were planned for education and information exchange between all levels of utility technical and operating management.

Vice presidents strengthen EPRI management

The Board of Directors named Richard Balzhiser and David Saxe vice presidents for Research and Development and Finance and Operations, respectively. The Fossil Fuel and Advanced Systems Division, formerly headed by Balzhiser, was organized into three divisions: Advanced Power Systems (Dwain Spencer, director), Coal Combustion Systems (Kurt Yeager, director), and Energy Management and Utilization (Fritz Kalhammer, director). Three other technical divisions, Electrical Systems (John Dougherty, director), Energy Analysis and Environment (René Malès, director), and Nuclear Power (Milton Levenson, director), were also placed under Balzhiser's general direction. The Board elected Edward McSweeney as treasurer, reporting to Saxe. Saxe is also responsible for Administrative Operations (Glenn Barber, director), Personnel (Howard Jurewitz, director), and Technical Information (open). Other moves saw Richard Rudman named director of the Policy Planning Division and Ray Schuster, director of the Communications Division (succeeding Robert Sandberg, now senior adviser). Rudman and Schuster, as well as the two new vice presidents, report to EPRI President Floyd Culler.

BALZHISER SAXE

Research strategy detailed

A new element was included in EPRI's outline of research proposed for the next five years. The key word is *strategy,* which was explained in the report *Overview and Strategy: 1980–1984 Research and Development Program Plan.* An increasing possibility of regional electricity shortages was cited as the basis for the Institute's strategy, which calls for primary attention to near-term improvements in nuclear and coal-fired power generation. Better process and cycle efficiencies, as well as power plant and environmental safety, were emphasized for their roles in conserving energy fuels and in holding down utility capital and operating costs.

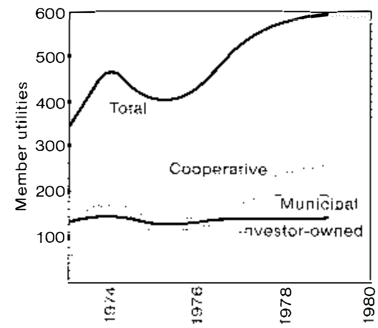
NOVEMBER

Establishing optimal tower designs

Mechanical research on transmission line towers and foundations was the subject of an $8.2 million authorization by EPRI's Board of Directors. The funds were designated for facility design and construction and two years of operation. Neither site nor contractor has been selected, but the Institute's schedule called for construction to begin by mid-1980 and research to be under way in early 1981. Dynamic testing will be used to refine structural designs and gain economies in the use of materials.

Utility membership nears 600

Northern States Power Co., Alpena Power Co., Hoosier Energy Division (representing 19 rural electric cooperatives in Indiana), and Platte River Power Authority (4 municipal utilities in northern Colorado) were among the 1979 additions to EPRI's membership roll. Also, the board of directors of the Missouri Basin Power Agency (45 municipal utilities) voted to support the Institute. Altogether, EPRI's member utilities deliver about 70% of the nation's electricity each year.



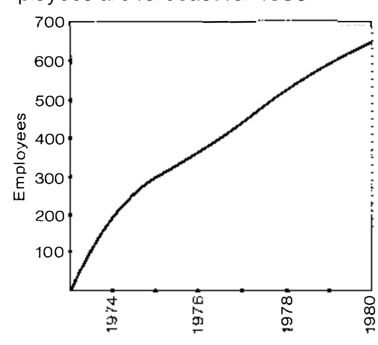
DECEMBER

Speeding contract negotiations

Revised procedures and time priorities helped EPRI cut its backlog of year-old transactions to only 5 from a total of 90 early in 1979. The timely contract action improved Institute accuracy in forecasting annual R&D expenditures.

Personnel growth rate slows

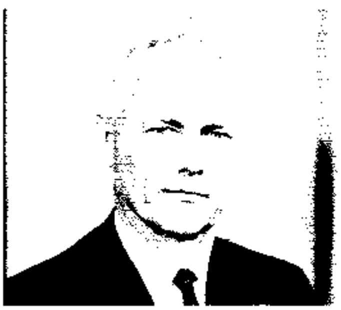
EPRI's 1979 year-end roster totaled 583 employees, up 11% since January. The count included 16 professionals on loan to the Institute, but it excluded 9 EPRI staff members on loan to other organizations. The 1979 increase, about 55 men and women, was smaller than for any previous year. About 60 new employees are forecast for 1980.



EPRI advisers retire

Company retirements ended the official EPRI advisory roles of two utility research executives whose synthesis of industry R&D goals 8 years ago catalyzed the formation of the Institute. Raymond Huse of Public Service Electric and Gas Co. (PSE&G) (New Jersey) concluded a 40-year career there, and Ludwig Lischer left Commonwealth Edison Co. (Illinois) after 42 years of service.

Huse chaired the R&D Goals Task Force appointed in 1970 by the industry's Electric Research Council (ERC), and Lischer was a task force member. Both men were named to EPRI's Research Advisory Committee (RAC) when it was formed in November 1973, Lischer serving as its first chairman until December 1977 and continuing as a committee member until his retirement. Huse was a member of RAC for three years, and after December 1976 he was a member of the New Energy Resources Task Force, another EPRI advisory group.



HUSE

ERC was organized in 1965 to support research of industrywide importance. The ERC task force guided by Huse produced a 1971 report that proposed utility industry R&D goals for the rest of the twentieth century and sketched the outline of a new organization to attain them. Together with the efforts of ERC's R&D Finance Task Force, the Huse report led to EPRI's incorporation and the appointment of Chauncey Starr as its president in 1972.

Huse, an engineering graduate of the University of New Hampshire (1938) and Harvard University (1939), became assistant to the general manager of engineering at PSE&G in 1969. A year later he was named manager of R&D, a position he held until he retired. For the last two years he was also vice president of the utility's subsidiary, PSE&G Research Corp.

Lischer, a 1937 Purdue University graduate, was named assistant system planning engineer for Commonwealth Edison in 1958 and manager of technical services in 1962. Elected vice president two years later, he thereafter headed the utility's engineering, research, and technical activities.

LISCHER

Advisory assignments came to be important occupations for both men. Fusion research was Huse's main focus, beginning in 1957 with a 4-year consulting assignment at Princeton's plasma physics laboratory. From 1967 to 1973 he was a member of Edison Electric Institute's Fusion Task Force, and during the same period he held shorter-term memberships on steering committees for fusion research at Princeton (as chairman), Cornell, and the University of Texas. Two other energy conversion avenues, fuel cells and magnetohydrodynamics, also attracted him to brief industry advisory service. Huse's longest advisory membership was from 1964 to 1973 on EEI's Research Projects Committee. That experience led to his chairmanship of the R&D Goals Task Force (1970–1971) and to his subsequent senior advisory roles with EPRI.

Engineering education was a longtime concern of Lischer: the Illinois Institute of Technology Board of Trustees, the University of Illinois Nuclear Advisory Committee, and the Purdue University Engineering Visiting Committee—the last service acknowledged by an honorary PhD awarded to Lischer in 1976. He was also on the board of the Chicago Engineering & Science Center. Like Huse, Lischer served on Edison Electric Institute committees and other industry committees; he was also named to advisory committees of the Federal Power Commission and the Nuclear Regulatory Commission, and from 1972 to 1979 he was a director of Project Management Corp., the utility-sponsored organization for design and construction of the Clinch River breeder reactor.

Pursuing EPRI's Goals

Setting the Goals

The Electric Power Research Institute must ensure that its R&D programs are focused on technologies that can be readily applied by the utilities. To achieve this purpose, it is essential that the research results provide hardware and information to meet the needs of existing systems and to develop advanced alternatives for the expansion of those systems. Prime emphasis is placed on minimizing future capital and operating costs to the benefit of both the utility and the rate payer.

To form a perspective on such R&D needs, EPRI's research must be responsive to a variety of economic, environmental, and social needs that affect the electric utilities and rate payers. EPRI's planning begins with a projection of the requirements likely to be placed on utilities to meet customer demands for electricity and then to build facilities, secure fuel, and protect the environment. The process continues with the formulation of key premises consistent with national energy issues. These topics are the framework for the 10 broad R&D goals of the Institute shown on the following pages.

The 10 goals have evolved from the objectives stated by the Electric Power Research Council in 1971. Refining them and establishing program priorities involves the combined efforts of EPRI's utility advisory committees and the EPRI technical staff, as well as coordination with federal and state energy agencies, regulatory bodies, and energy research organizations in other countries.

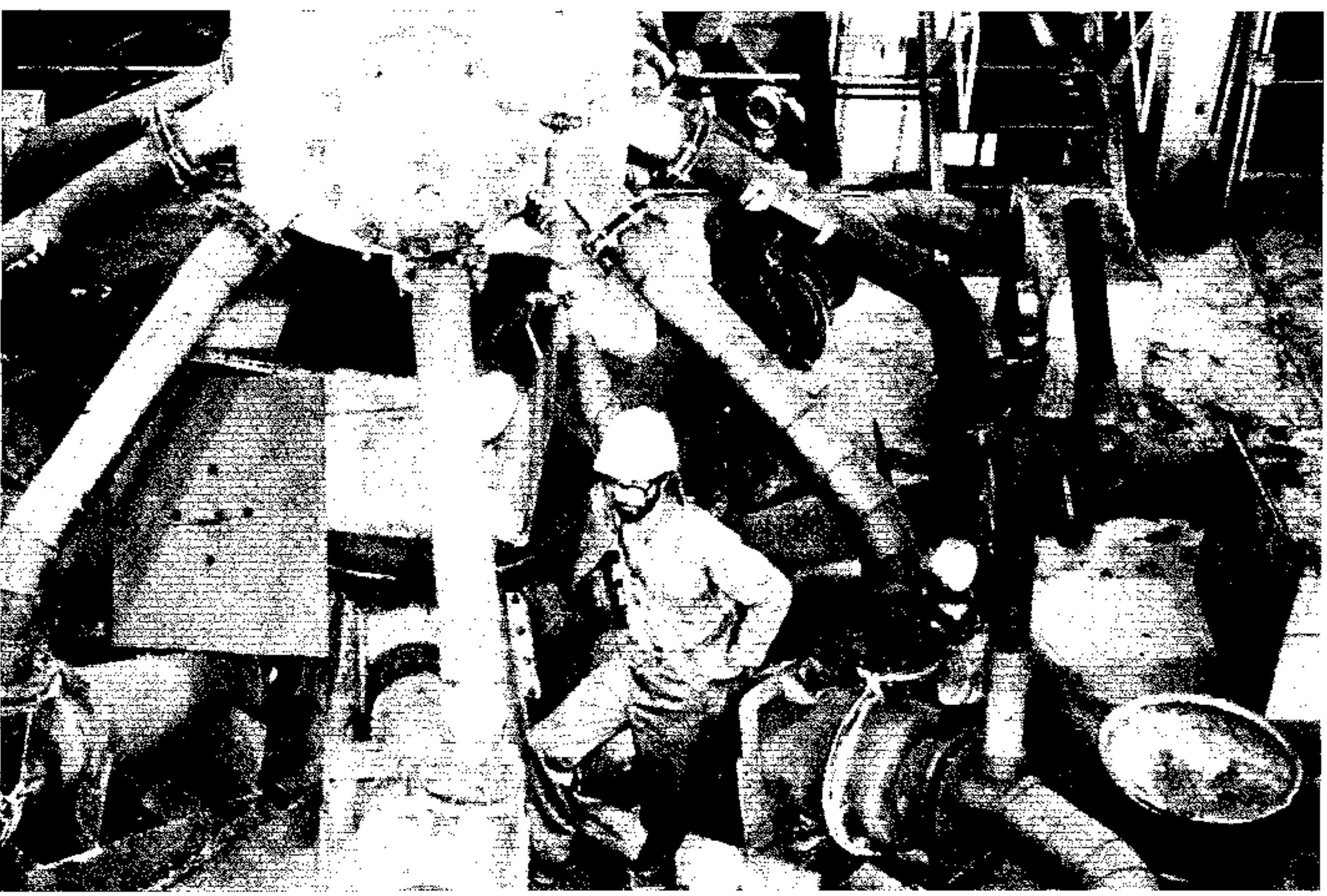
Coal Liquids

Coal liquefaction processes yield liquid fuels that could provide electric utilities with a substitute for petroleum and natural gas. Production facilities in the future will produce fuels with consistent quality, competitive prices, and environmental acceptability. Construction of two large coal liquefaction pilot plants is now nearing completion. These projects are supported by EPRI, DOE, and private industry. The H-Coal process, a direct catalytic technique, will be employed at Catlettsburg, Kentucky. This plant will process 250 t/d of coal to produce distillate oil and 600 t/d for heavy boiler oil. The Exxon Donor Solvent process will be used at a plant in Baytown, Texas. There, 250 t/d of coal will yield distillate fuel. Both plants are expected to begin two-year operating programs in early 1980. Coal liquids could be in commercial use by the mid-1980s. (RP238, RP778)

Coal Cleaning

A carload of coal contains more than just fuel: sulfur, ash, rock, and moisture come along for the ride. Sulfur forms SO_2 during combustion; ash can cause boiler fouling and slagging problems; rock and moisture inflate shipping costs. Many of these impurities can be reduced through physical coal cleaning, so EPRI is exploring ways to improve old cleaning methods and develop new ones. At Homer City, Pennsylvania, for instance, EPRI

and EPA are cosponsoring performance tests at a 1200-t/h advanced cleaning facility owned by Pennsylvania Electric Co. and New York State Electric & Gas Corp. This past fall, one mile north of Homer City, EPRI broke ground for its own 20-t/h coal-cleaning test facility. This highly flexible installation, able to simulate up to 50 different commercial flow sheets, is expected to begin operation in 1981. (RP1029, RP1400)



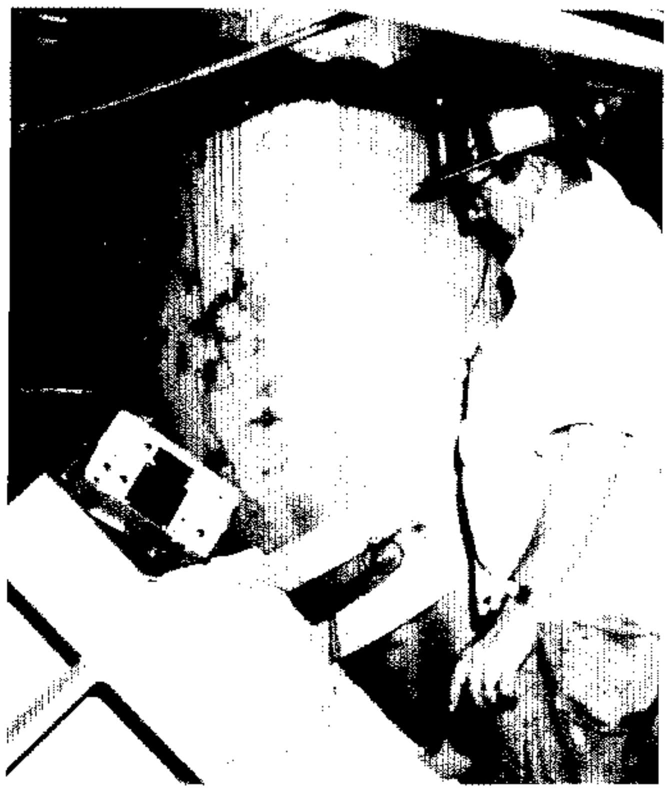
2

Seismic Tests

Nuclear reactor containment buildings are designed on a conservative basis to withstand earthquakes. Using explosives for testing, EPRI is studying the interaction of soil with scale models of containment structures to provide guidelines that permit the elimination of unnecessary and costly conservatism. Researchers at Science Applications, Inc.; the University of New Mexico; Fugro, Inc.; Weidlinger Associates; and URS/John A. Blume & Associates, Engineers, used mathematical models to simulate soil behavior. Present containment designs are based on linear movement of soils. EPRI's work focuses on determining the effect of nonlinear soil movement, which tends to lessen seismic impact on structural foundations. The extent of nonlinear soil movement effects indicated by the models will be verified by data gathered during actual earthquakes. (RP307, RP810)

Nondestructive Evaluation

Significant progress was made during 1979 in EPRI research on nondestructive examination, particularly in the improved ultrasonic inspection of stainless steel pipe welds. For instance, Southwest Research Institute developed an optimized dual-element transducer, which is now used during routine in-service inspection of stainless steel pipe joints in nuclear plants. Adaptronics, Inc., assembled a system for automatically detecting and sizing flaws by ultrasonic techniques. To assist in verifying inspections, Ishikawajima-Harima Heavy Industries Co. Ltd. Research Institute developed techniques to fabricate pipe samples with flaws of known dimensions. Through the cooperation of Rheinisch Westfälisches Elektrizitätswerk Ag, EPRI was able to obtain samples of pipe that had cracked in service; these were vital in evaluating the new inspection techniques. (RP892, RP1125)



3

Reliability

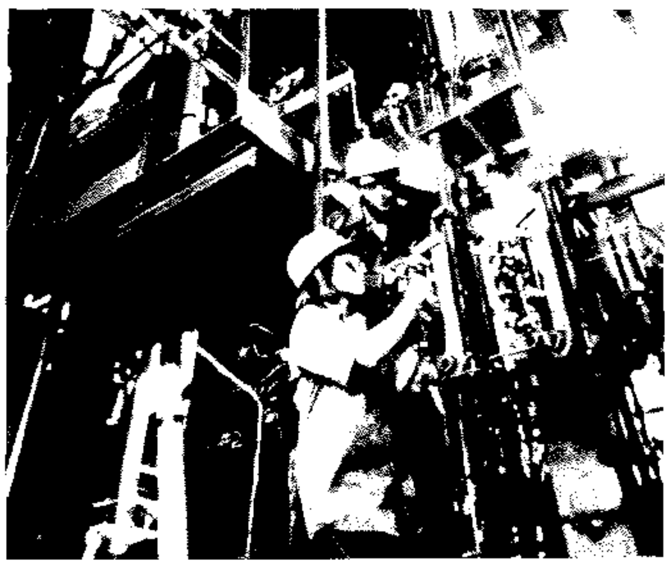
The declining reliability of large fossil-fueled power plants is a matter of serious industry concern. EPRI is working to halt this downward trend through approximately 70 different contracts aimed at turbine blade failures, boiler fouling and slagging, and the like. Turbine blade failure can occur when minute amounts of impurities in turbine steam condense and deposit on blades. Corrosion begins, leading to cracks in highly stressed areas and eventual fatigue failure. If failure is severe enough, an entire turbine may have to be replaced at a cost of millions of dollars and up to two years of downtime. In the coming year EPRI and Westinghouse Electric Corp. will replace conventional steel turbine blades at Commonwealth Edison Co.'s Kincaid station with others of a titanium alloy to evaluate the new alloy's corrosion and fatigue resistance. (RP912, RP1264)

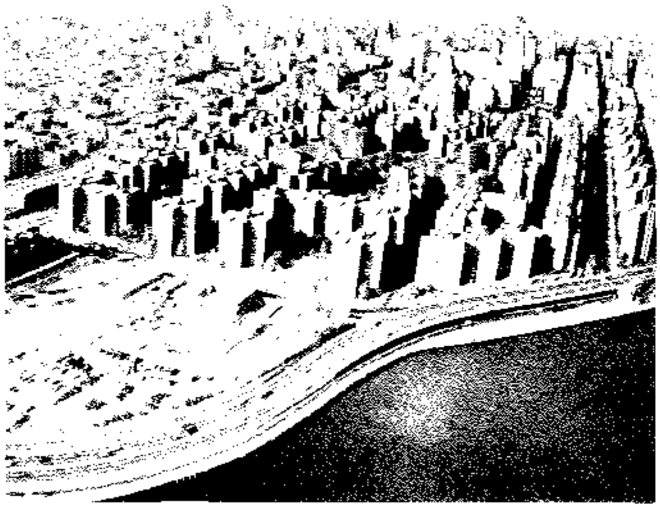
Fuel Cells

The fuel cell—efficient over a wide range of loads, quick to respond to demand changes, clean, quiet, and modular—is moving closer to commercial utility status. In New York City, equipment delivery for a 4.5-MW fuel cell demonstration cosponsored by EPRI and DOE on Consolidated Edison Co.'s system will be completed by early 1980; a 2200-h validation test will be finished by 1981. Technological efforts to upgrade the cells themselves continue. EPRI, DOE, and several utilities are now considering funding a $50 million program to complete design, specifications, and technical verification of a commercial fuel cell power plant technology by 1983. A fuel cell users group is being formed with EPRI assistance. This group will work with manufacturers, EPRI, and the government to expedite the commercial deployment of fuel cells by 1985. (RP842, RP1677)

Fluidized-Bed Combustion

Atmospheric fluidized-bed combustion (AFBC) may provide the utility industry with unique emissions control, increased reliability, and greater fuel flexibility by as early as 1990. AFBC boilers comprise a bed of coal and limestone fluidized by forced air. Limestone absorbs SO_2 emissions. Relatively low bed temperatures, made possible by improved heat transfer efficiencies, suppress NO_x formation and eliminate slagging problems. EPRI's 6-by-6-ft, 2-MW (e) AFBC pilot plant, located at Babcock & Wilcox Co.'s Alliance (Ohio) Research Center, began operation in 1978. This fully instrumented pilot is testing design innovations, such as increased boiler freeboard. TVA recently opted to build a 10–20-MW (e) pilot based on the results achieved in the 6-by-6-ft facility. The TVA pilot will be used to test full-size hardware and process designs that are too large for the 6-by-6. (RP718)





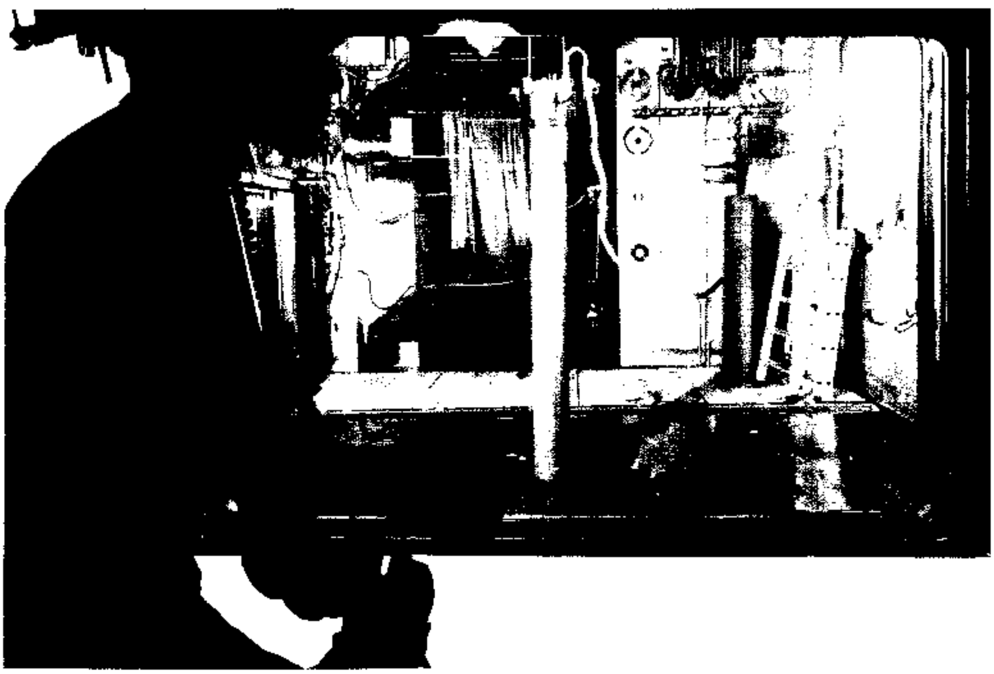
4

Nuclear Fuel Cycle

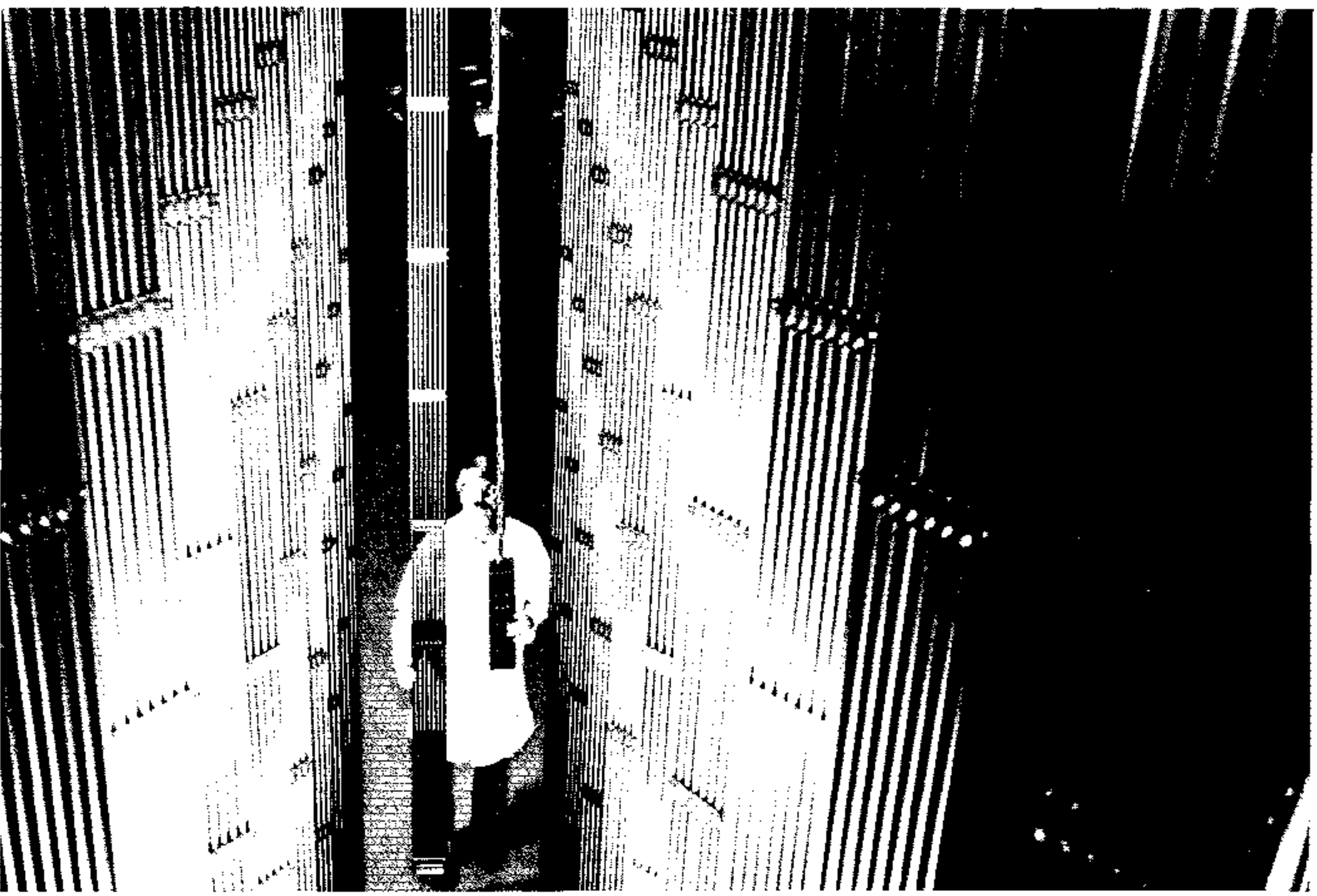
Achieving the full economic and resource potential of the nuclear fuel cycle depends on reliable fuel performance and on publicly acceptable fuel cycle processes. With the exception of a geologic repository for nuclear waste, such processes have been operating under government control for several decades. Because a major fraction of the existing wastes are from weapons programs, the government is taking steps to solve the disposal problem—selecting repository sites and scaling up process technology to safely dispose of nuclear waste. Recognizing the importance of waste disposal implementation to public acceptance of nuclear power, EPRI is focusing on the technical assessment of government-sponsored research, constructive suggestions to the program directors, and communication of program accomplishments to utilities and the public. (RP767, RP1579)

Fuel Performance

Because the reprocessing and recycling of nuclear fuel has been deferred in the United States, ways must be found to reduce the uranium and enrichment requirements of the once-through fuel cycle. Of various options, extended burnup of fuel offers the best near-term, practical prospect. However, extended burnup is accompanied by increased corrosion of the outside surface of the nuclear fuel rods and by increased release of fission gases from the fuel



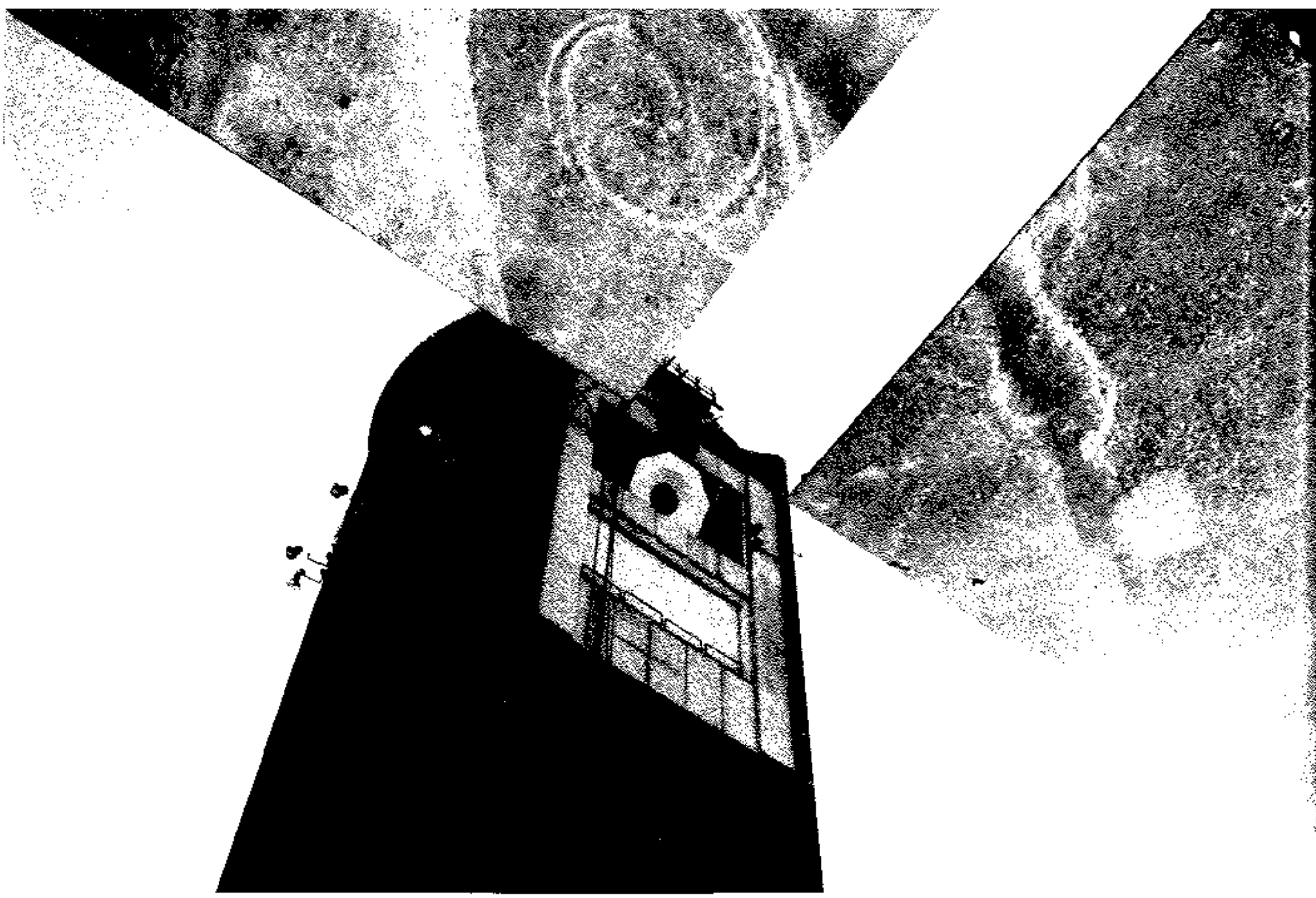
pellets inside the rods. These phenomena may degrade fuel performance at extended burnups. Corrosion product buildup is therefore being investigated by Combustion Engineering, Inc., and Kraftwerk Union Ag. The release of fission gases is being studied in projects with U.S. nuclear fuel vendors, as well as in an internationally sponsored effort. (RP1250, RP1702)



5

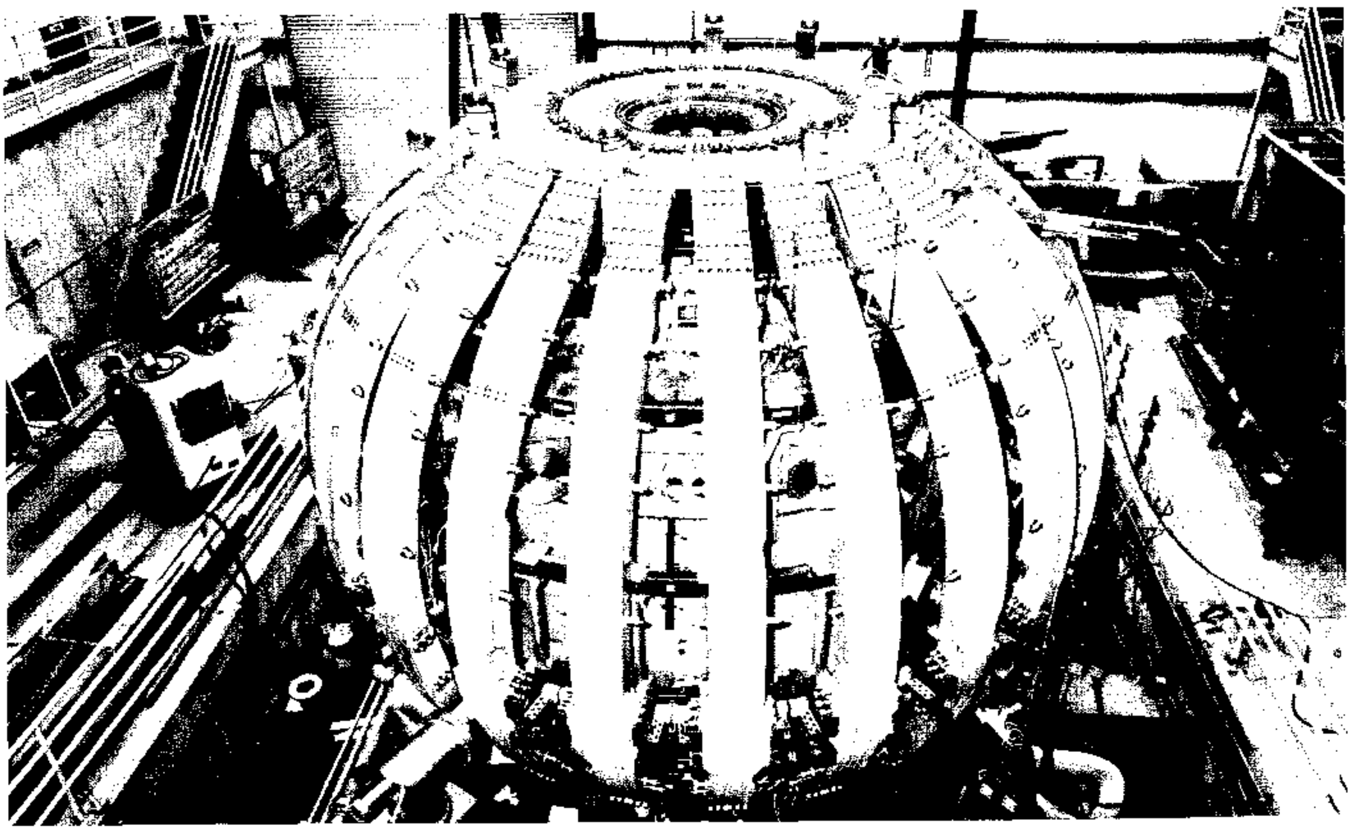
Solar Receivers

In preparation for tapping the sun's energy to drive a conventional turbine-generator, EPRI successfully tested the first of two gas-cooled, solar central receivers at DOE's test facility near Albuquerque, New Mexico, in 1979. This first concept, a closed Brayton-cycle (gas turbine) system, features a 1-MW (th) receiver whose superalloy heat exchanger heats air to 815°C (1500°F). Tests exposed the receiver to operating conditions expected at future solar-thermal power plants and confirmed the design and performance models developed by Boeing Engineering & Construction, the prime contractor. The second concept, an open Brayton-cycle system, is being developed by Black & Veatch Consulting Engineers to heat air to 1065°C (1950°F) in the receiver's silicon-carbide heat exchanger tubes. This receiver will be tested in 1980. (RP377, RP475)



Doublet III

A fusion reaction that unites hydrogen atoms to yield energy may provide electric utilities with an inexhaustible source of energy around the year 2025. The necessary deuterium fuel is readily available at low cost from water. However, for fusion power reactors to be feasible, their plasma must be rigorously confined and heated to temperatures of 100 million degrees Celsius. Attainment of these break-even parameters is the goal of Doublet III, an experimental reactor in San Diego, California. EPRI sponsored Doublet III's engineering design; DOE sponsored its construction and operation by General Atomic Co. Physics tests began in March 1979. With recently acquired financial and technical assistance from the Japanese Atomic Energy Research Institute, Doublet III is expected to achieve the necessary plasma parameters by the early 1980s. (RP115)



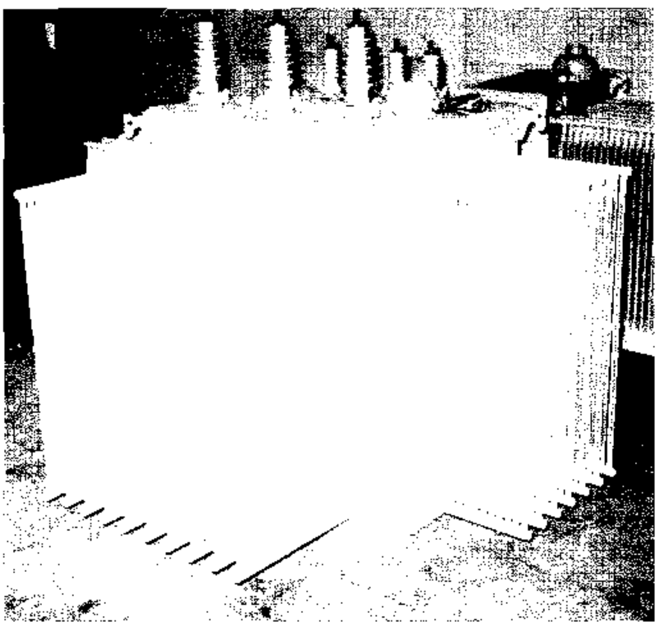
6

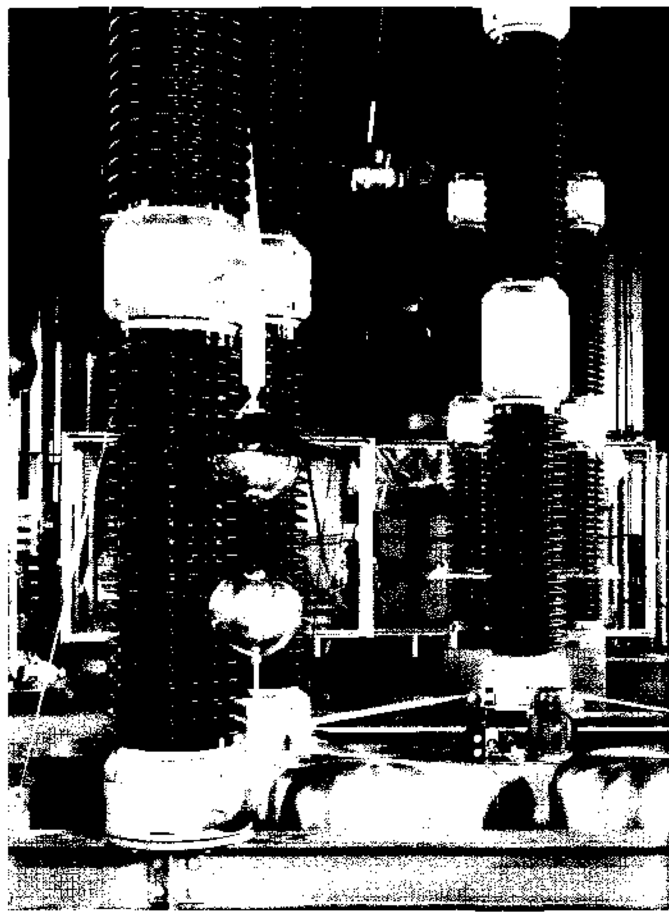
Vapor-Cooled Transformers

Transformers have been cooled and insulated in various ways. Oil-filled models, while relatively inexpensive, are potential fire hazards; polychlorinated biphenyl transformers are environmentally unacceptable; silicone transformers are 40–50% more costly than oil. EPRI and Westinghouse Electric Corp. have developed two vapor-cooled transformer designs that are fire-resistant and only 5–18% more expensive than oil-filled models. In one, transformer core and coils are submerged in tetrachloroethylene and oil; vapors form as bubbles at hot spots to transfer the heat and then condense within the liquid. In the second design, a pump circulates a fluorocarbon liquid coolant over core and coils; resultant vapors provide the heat transfer and are circulated through coolers, condensed, and recirculated. SF_6 provides insulation for cold starts. (RP930)

High-Voltage DC

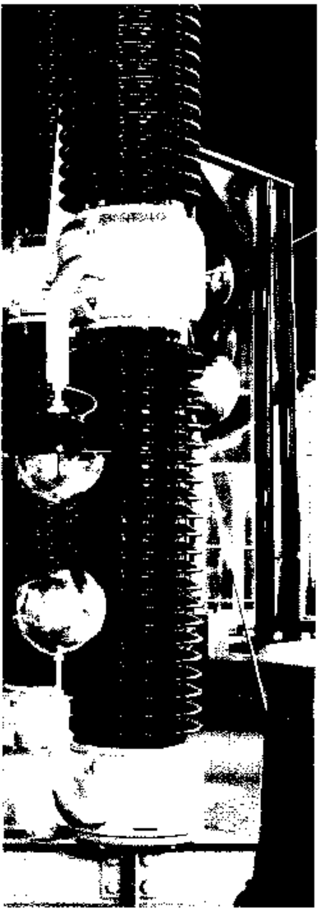
Growing populations need more electricity, but as they expand they engulf the right-of-way corridors that would be used to bring in additional power. Higher voltages are providing part of the answer: more power transmitted through the same corridors. Dc transmission, which permits a higher power density on a given right-of-way (while promoting greater system stability), may supply the rest of the answer. EPRI has just concluded its research into ultrahigh ac voltages at General Electric Co.'s Lenox test facility near Pittsfield, Massachusetts, and the *Transmission Line Reference Book—345 kV and Above* will be revised to include design information for systems up to 1200 kV ac. The lines at the Lenox facility are now being reconfigured to develop design data for high-voltage dc lines up to ±1500 kV. (RP1282)

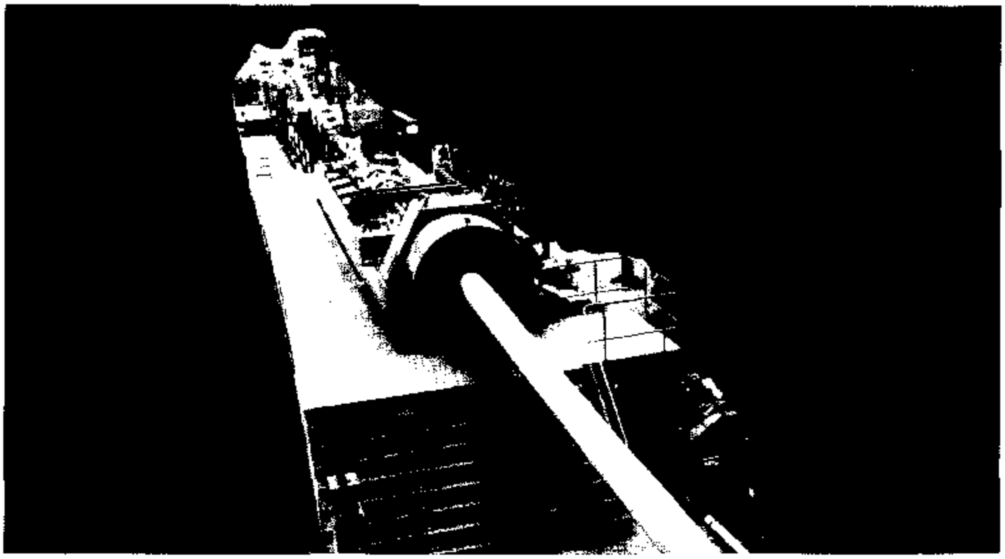




Flexible Gas Cable

The development of a flexible gas-insulated power transmission cable offers utilities easier handling, transportation, and installation. A section of flexible gas cable withstood tests at EPRI's Waltz Mill Underground Cable Test Facility, where it was pulled into a trench, around bends, and under and over typical field obstructions. It sustained no damage or change in its electrical integrity. The goal of the project is the fabrication of 362-kV flexible gas cable. In 1979 a special fabricating machine designed by Kabelmetal of Hanover, West Germany, was installed by Gould–Brown Boveri Inc. at a facility in Bridgeport, New Jersey. Production of a full reel of 362-kV flexible gas cable in the United States is scheduled for the first quarter of 1980. (RP7837)





7

Rate Design

At the request of the National Association of Regulatory Utility Commissioners (NARUC), EPRI has been examining ways of controlling growth in peak demand for electricity and of shifting loads to off-peak periods. For example, EPRI's Electric Utility Rate Design Study has supported the development of models that assist in analysis of the changes in costs associated with various load management strategies. The Rate Design Study has analyzed time-differentiated rates, customer response to price, and cost-benefit ratios. In 1979 it prepared the *Reference Manual and Procedures for Implementing PURPA* (Public Utility Regulatory Policies Act of 1978). Consultants' reports from the current (second) phase of the Rate Design Study's work should be available by early 1980. (RP434)

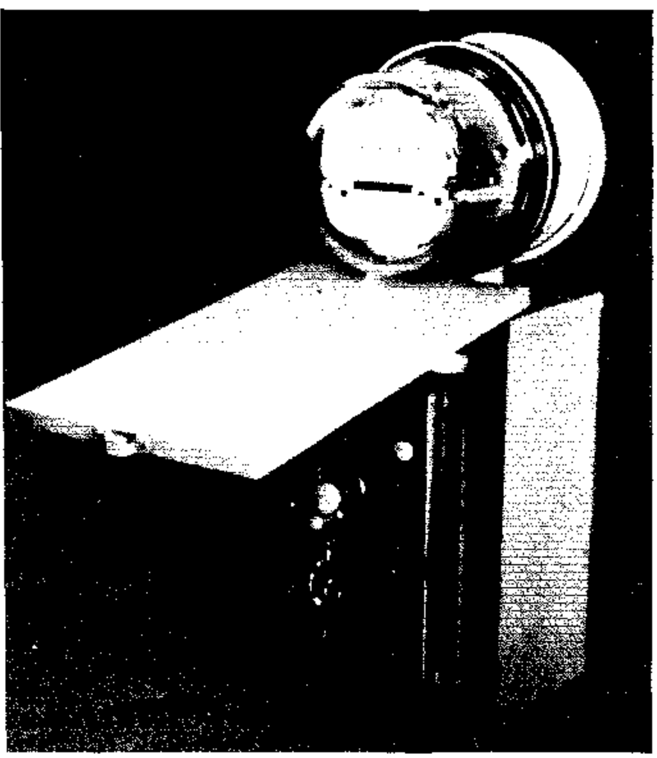
Distribution Automation

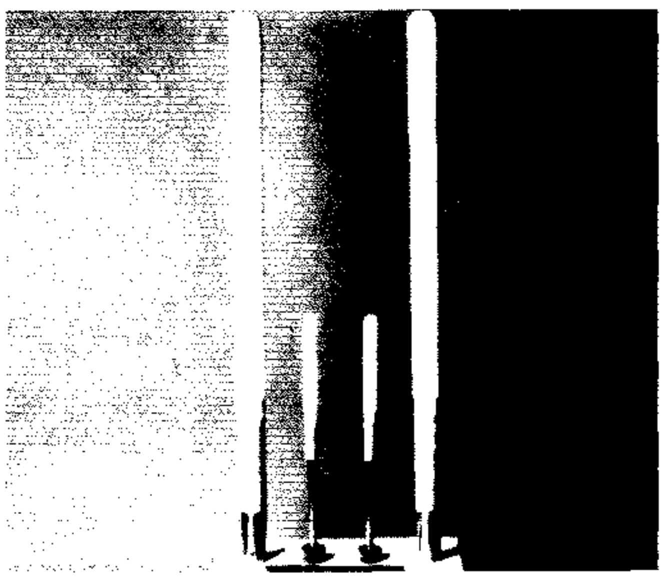
Distribution automation—automatic communication and control within an electricity distribution network—cannot be accomplished without a reliable and cost-effective communication system. EPRI and DOE are cosponsoring the test and evaluation of 6 two-way communication systems in large field installations on host utility systems. Three communication techniques (radio, telephone, and power-line carrier) are being tested.

Four systems will include at least 700 customer meters on urban, suburban, and rural feeders that vary from 3 to 10 miles long; both overhead and underground feeders will be included. Systems will be tested in industrial, commercial, and residential environments. After completion of these projects in September 1980, EPRI expects to know which distribution automation techniques will be feasible and cost-effective. (RP850, RP1535)

Battery Energy Storage

Battery systems that generate peaking power during heavy demand periods and recharge during off-peak periods may give utilities a much-needed alternative to petroleum fuels. Zinc-chlorine and sodium-sulfur batteries (top choices for utility energy storage) are being developed by EPRI. A 5-MWh zinc-chlorine battery module will be built in 1981 by Energy Development Associates, funded by DOE and EPRI. With EPRI support, General Electric Co. will assemble four 100-kWh sodium-sulfur batteries during 1980–1981 and a 5-MWh prototype during 1984–1985. In 1981 testing and evaluation of the zinc-chlorine battery in commercial operation modes will begin at the Battery Energy Storage Test Facility, Hillsborough Township, New Jersey. The nearly completed BEST facility will be operated by Public Service Electric and Gas Co. for DOE and EPRI. (RP128, RP226, RP255)





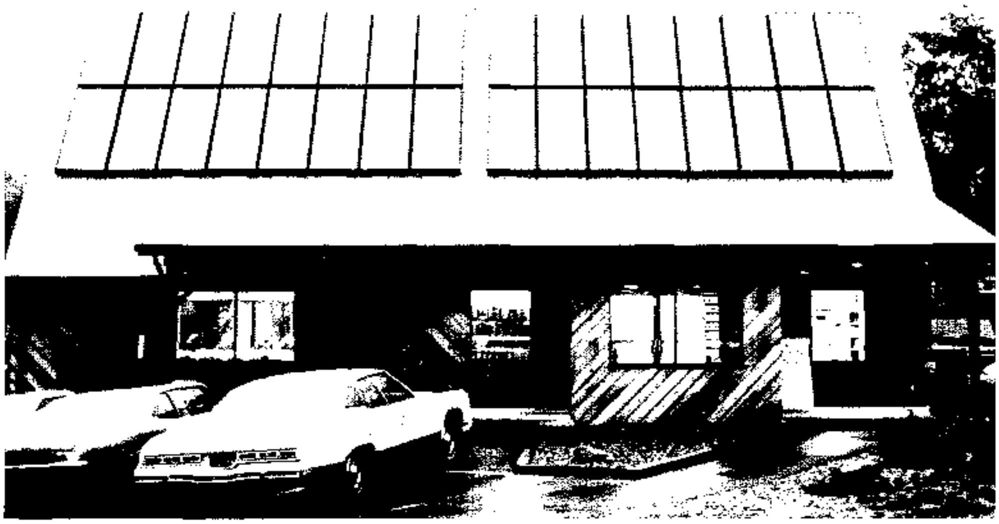
8

Solar Heating and Cooling

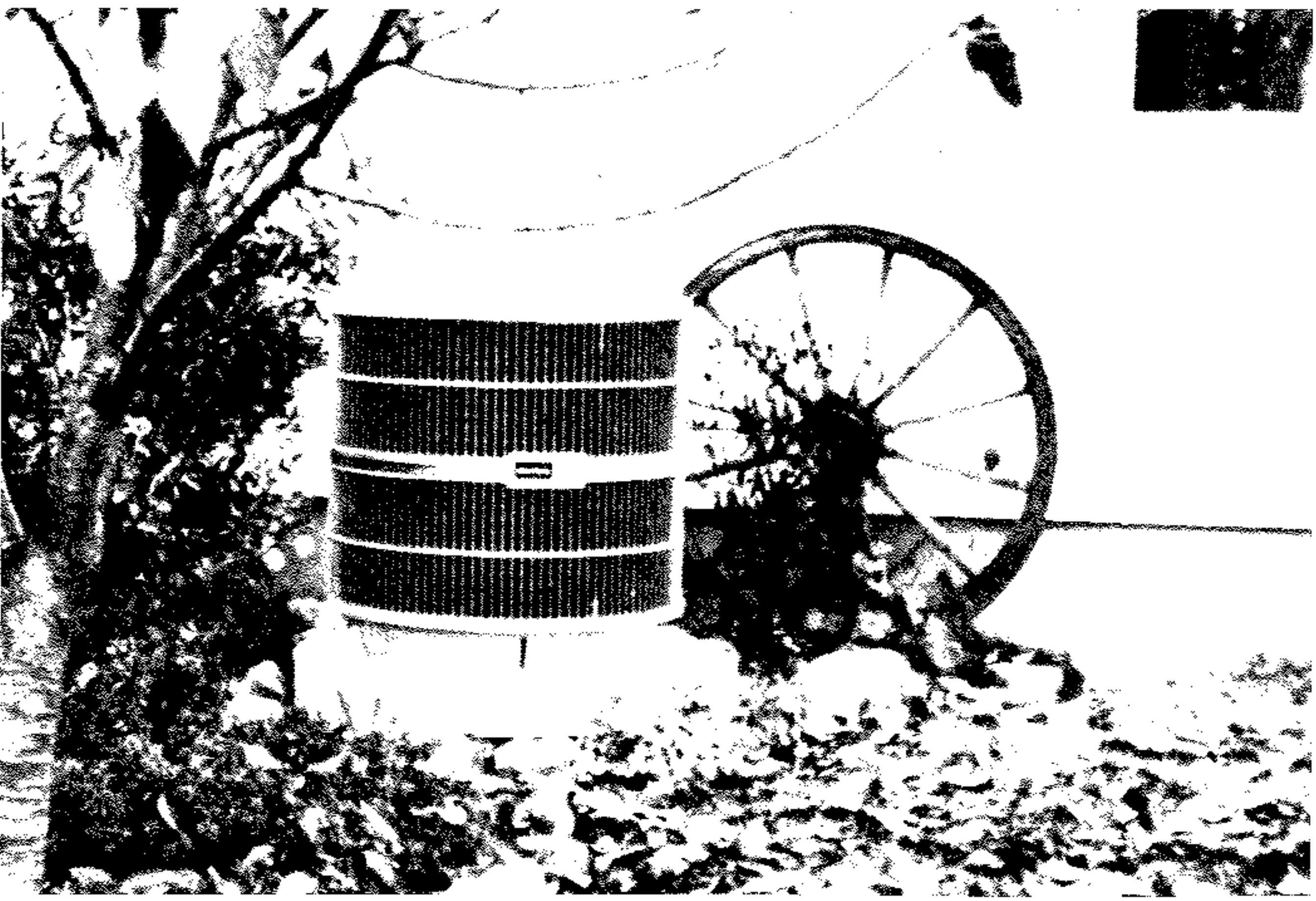
As increasing numbers of commercial buildings go solar, utilities need to know what effect stretches of extreme weather will have on the backup energy demand for heating and cooling these buildings. EPRI intends to find out by monitoring solar heating and cooling installations on six different commercial buildings, including a Connecticut delicatessen and an Indiana credit union office. Instrumentation will be in place by mid-1980. Data will be transmitted to systems contractor Arthur D. Little, Inc., where they will be analyzed to determine the most cost-effective systems, considering both the installed cost of the solar and load management equipment and the utility cost of supplying the required backup energy. This project complements an earlier EPRI study on residential solar installations, for which preliminary data are now being analyzed. (RP549, RP844)

Heat Pumps

Heat pumps run entirely on electricity and seem a good heating alternative for homeowners facing the high costs and supply uncertainties of oil or natural gas. Compared with conventional electric resistance heaters, heat pumps are more efficient. However, many heat pump installations are insufficient for the coldest winter days, especially in northern climates, and they require backup resistance heating. Several years ago EPRI, with Carrier



Corp. and Niagara Mohawk Power Corp., initiated a cold-climate performance study of five state-of-the-art heat pumps to see exactly what they could do. Using the resultant baseline data, Carrier was able to design a modified pump that incorporates improved equipment design and a more efficient defrost cycle. EPRI plans expanded studies to assess heat pump performance in intermediate climates. (RP789, RP1495)



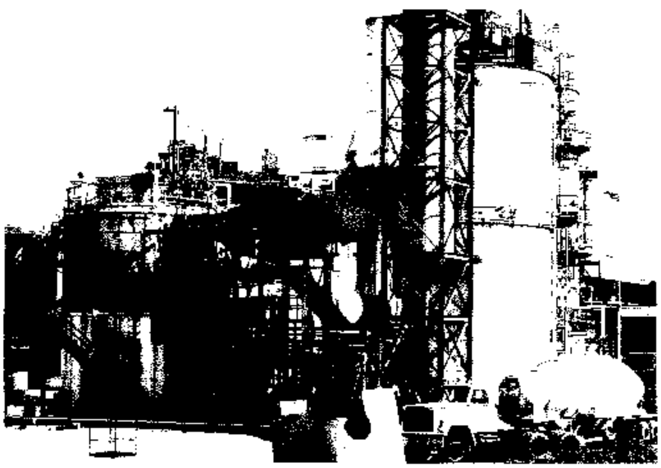
9

Stack Gas Scrubbers

Environmental restrictions on stack gas emissions and the move toward greater use of coal for electricity generation are two reasons why EPRI is intent on improving stack gas scrubbers. Several advanced SO_2 control systems are being demonstrated as part of EPRI's Desulfurization Processes Program. The Chiyoda Thoroughbred-121 process, which combines low cost, simplicity, and reliability with an inexpensive limestone reagent and a salable gypsum by-product, had a successful prototype evaluation in 1979. The absorption–steam stripping–reduction system, which recovers sulfur and may be economically competitive, is being tested on the pilot and prototype scales. EPRI is seeking host utility sites for full-scale demonstration of these processes so they can be ready for commercial orders in 1983 and 1984. (RP536, RP784)

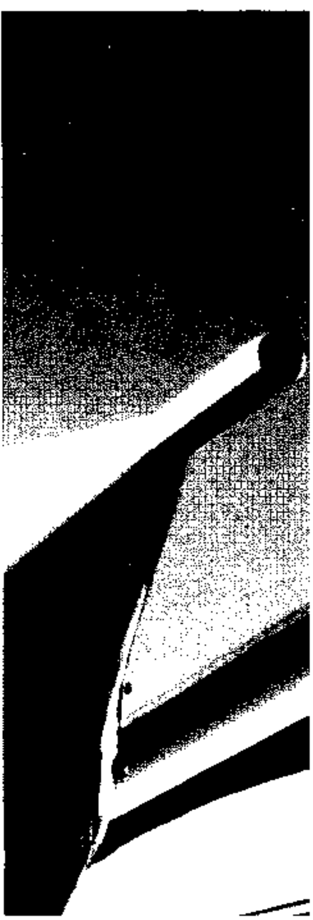
Atmospheric Sulfate Measurement

The Sulfate Regional Experiment (SURE) was established to identify the contribution of the electric power industry to atmospheric sulfate levels in the northeastern United States. Researchers measured emissions and meteorological conditions from ground stations and from specially equipped airplanes. They drew up an emissions inventory from which daily averages were reported for each season and developed a modeling program for predicting regional sulfate concentrations. Environmental Research & Technology, Inc., coordinated these activities. In 1979 researchers were able to determine sulfate distributions and concentrations in the region, and as a result, improved methods for predicting sulfate levels were developed. Final results of the project are due in June 1980. (RP862-1, RP862-2)



Animal Toxicology

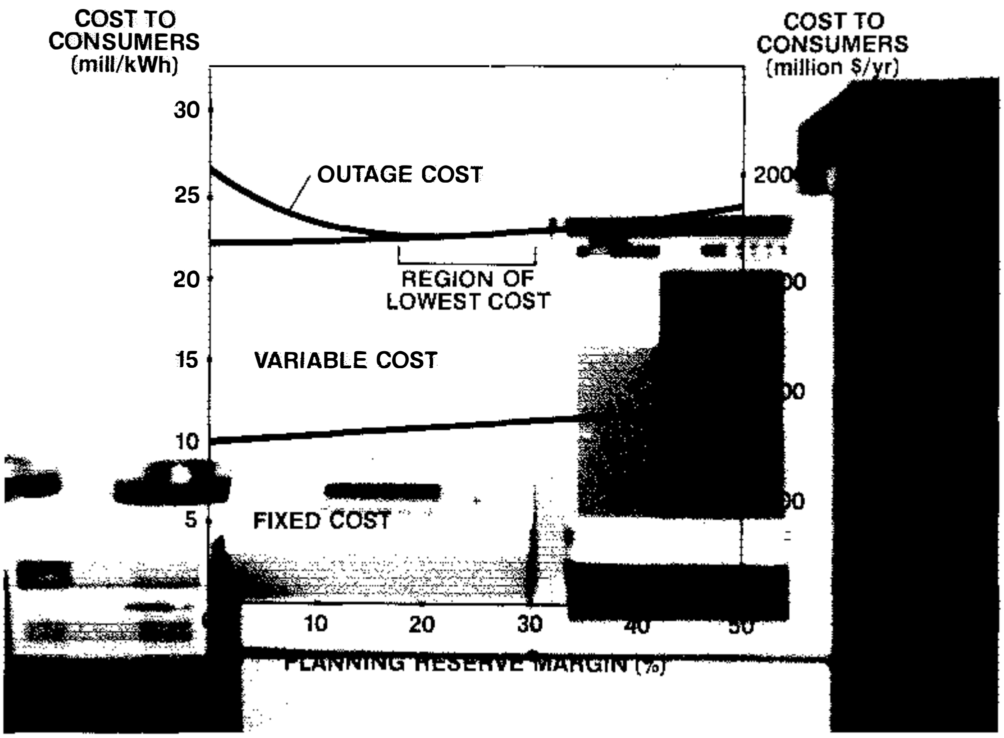
Community welfare, the standards setting process, and control technology require comprehensive studies that identify and predict the human health effects of electricity generation and transmission. Investigators at the University of California at Davis, for instance, are examining the effects of different concentrations, exposure times, and combinations of effluents on respiratory systems of animals. One study in 1979 measured differences in gas and particulate concentrations between indoor and outdoor environments. Other studies demonstrated the absence of adverse health effects, such as changes in tissue or increases in infection, from a variety of inhaled pollutants. In 1980 current projects will be expanded and new research will begin in carcinogenicity testing and occupational health. (RP1001, RP1112)



10

Planning Generation Capacity

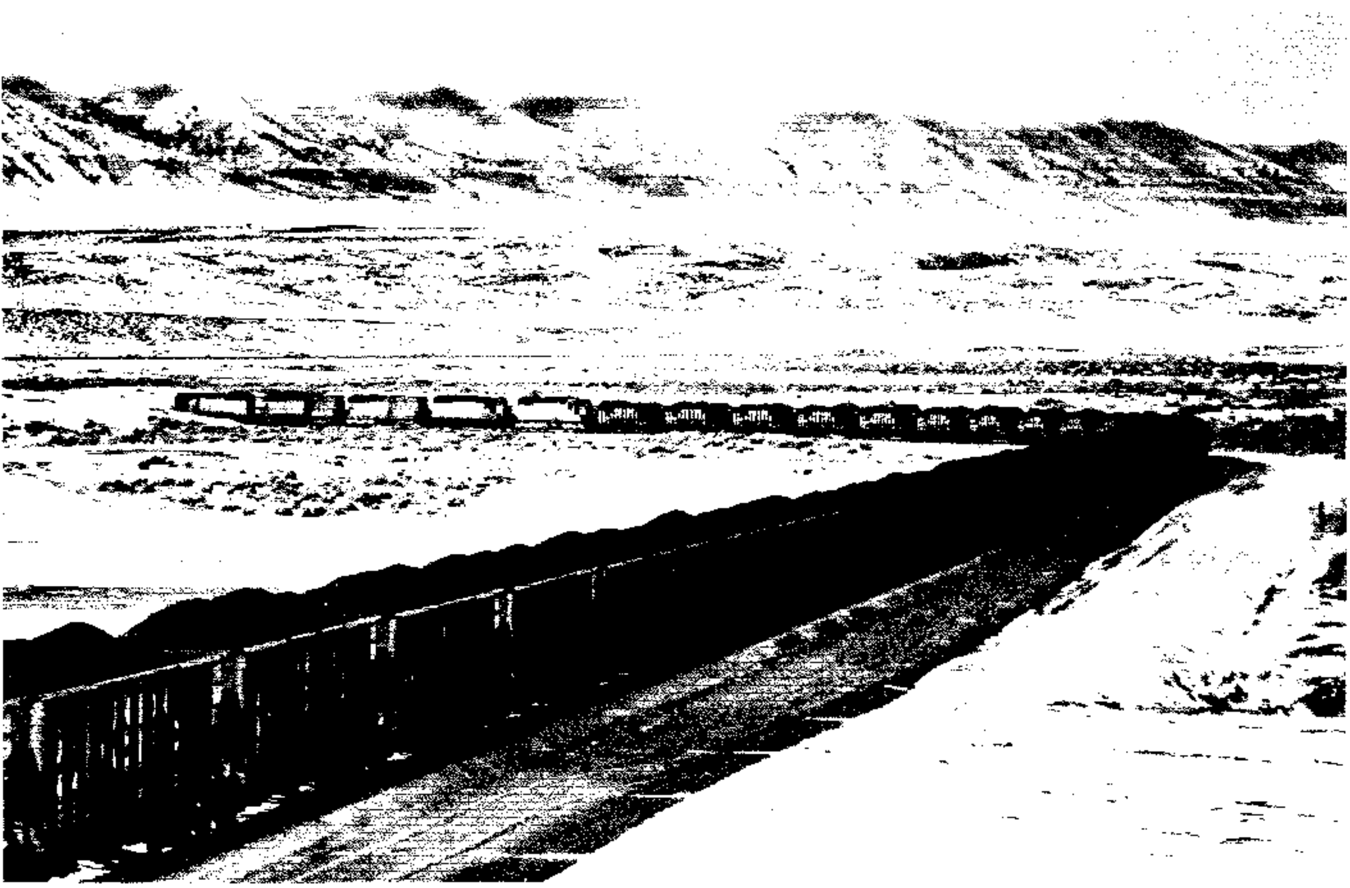
Though tomorrow's demand for electricity is uncertain, utility managers must decide today how much to expand future generating capacity, particularly since lead times for power plant construction are increasing. Decision Focus, Inc., produced a methodology that takes uncertainty into account in estimating the costs and benefits to utilities and consumers that are associated with different levels of expansion. The over/under capacity planning model was developed from that methodology and in 1979 was distributed to 60 utilities, consultants, and regulatory commissions. In 1980 Decision Focus will extend the methodology to include the uncertainties that affect the desirable mix of technologies used in electricity generation. (RP1107)



Coal Supply

As the nation moves toward greater reliance on coal, understanding and evaluating coal industry developments become increasingly important for EPRI and utility planning. EPRI is studying many facets of the coal industry, including geology, mining and preparation costs, transportation, labor supply, and future coal markets. An integrated set of models and data bases designed to provide improved and consistent minemouth coal supply forecasts

is being developed under the direction of Charles River Associates Inc. Work in the important area of coal transportation is continuing with a major new effort under way with C.A.C.I., Inc.—Federal to better forecast coal transportation costs and analyze the impact of new technologies and network structures on coal transportation. (RP1009, RP1219)



EPRI-DOE Cooperation in Energy Research

EPRI and DOE share interests that have led to extensive cooperation in energy R&D. Last March the two organizations signed an agreement formalizing that partnership and encouraging future joint and coordinated efforts.

In Baytown, Texas, construction is nearing completion on a $110 million pilot plant for producing clean liquid fuel from coal by the Exxon Donor Solvent process. The major cofunders of the plant with Exxon are EPRI and DOE.

In Hillsborough Township, New Jersey, a $14 million national facility for testing advanced energy storage batteries begins operation this fall. Sponsoring this effort with the host utility, Public Service Electric and Gas Co., are EPRI and DOE.

And in Manhattan, a 4.8-MW fuel cell demonstration plant begins operation this fall on the system of Consolidated Edison Co. of New York, Inc. EPRI and DOE are cofunding this effort with United Technologies Corp.

Jointly funded projects such as these are examples of one form of cooperation that exists between EPRI and DOE. At the present time EPRI and DOE are cofunding approximately $350 million in some 20 research projects.

But cooperation takes many forms between these two organizations that represent, respectively, the largest private and public sponsors of electric power research, development, and demonstration in the country. It embraces not only joint funding but also jointly managed–separately funded projects, parallel research efforts, resource sharing, and information exchange. In the total context, EPRI and DOE cooperate on hundreds of research projects in almost every area of technology related to the production, delivery, and use of electric power.

The roots of EPRI–DOE cooperation go back beyond the formation of either organization to the interface that existed between the utility industry's Electric Research Council (ERC) and the early federal energy organizations—the Atomic Energy Commission (AEC) and the electricity research sections of the Department of the Interior (DOI). When EPRI was formed in 1972, the ERC-managed research projects were transferred to EPRI. In 1974 EPRI and AEC signed a Memorandum of Understanding for cooperation in energy research, development, and demonstration. That agreement was superseded in May of 1976 by a similar agreement with AEC's successor agency, the Energy Research and Development Administration (ERDA). EPRI officials estimate that within the general framework of the AEC and ERDA agreements, over 100 research projects with a total value of more than $800 million (including funding from other sponsors) were either jointly planned or jointly funded.

In March 1979, after extended negotiation, EPRI signed a similar agreement with DOE. The document modified previous agreements and formalized the existing and extensive network of cooperation between two organizations that are in the forefront of national efforts to secure a safe and reliable energy future.

David Saxe, EPRI's vice president for finance and operations, was a key figure in negotiating what was termed the "participation agreement." He sees it as a valuable tool in formalizing cooperation.

"The agreement with DOE establishes a framework that permits and encourages cooperative work without either party giving up its independence or its ability to do its own planning," comments Saxe. "At the same time it allows both organizations to plan programs with greater knowledge of what the other is doing so that neither operates in a vacuum."

Saxe adds that the document also helps in clearing up uncertainty about what is and what is not appropriate for either organization to do in cooperative endeavors. "It spells out for anyone who has questions or concerns just what are the proper bounds," he notes.

For example, the document specifies that the scope of the cooperation is limited to DOE's research role, specifically the DOE units directed by the assistant


FUMICH


PARRY


SAWHILL

secretaries for energy technology, conservation and solar applications, resource applications, environment, and defense and by the director of energy research. (Although DOE has reorganized parts of its research section since July and the titles of some units have changed, the same basic principle of limiting cooperation to the research areas applies.) "Both organizations wanted to make very clear that EPRI is not involved in the regulatory side of DOE," says Saxe.

The participation agreement sanctions a number of different forms of cooperation. Among them are joint funding, parallel work, sharing facilities, and information exchange.

Perhaps the most recognizable of these is joint funding, and indeed EPRI and DOE are jointly funding a number of large test facilities, pilot plants, and research projects. For the future, the agreement specifies that joint funding will primarily be used for projects estimated to cost $10 million or more. "The aim was to avoid the complexities of dual sponsorship of projects that are small enough for either organization to fund alone," explains Saxe. He adds that this is only a guideline and there may be exceptions.

The new agreement also provides that for a project to be considered as falling under the joint funding provisions of the agreement, EPRI must contribute at least 35% to the total lifetime cost, unless both organizations agree that special circumstances exist.

Because of federal law, the participation agreement gives DOE the ultimate responsibility for securing research proposals, evaluating them, selecting the contractor, negotiating the contract, and subsequently managing the project. Jointly funded projects are carried out under contract between DOE and the contractor, with EPRI participating at all stages, from developing the request for proposals through managing and funding the contract. EPRI is a member of the project management team, but DOE designates the project manager, and representatives on the team are generally proportional to each party's funding contribution.

Is it worth it, then, for EPRI to contribute a smaller amount and perhaps accept a lesser role? Saxe insists that it is. He points to the statement in the agreement that reads, "It is the intention of the parties that jointly funded projects be managed with a maximum of cooperation and mutuality."

Saxe explains that the agreement is really a framework. "It depends very much on working relationships and on the respect that individuals have for each other's capabilities and intellectual contribution to a project—not just dollars. If we put up good people who are able to make a substantial contribution to the technology and the management of the project, people who are respected by their counterparts at DOE, they sit down as equals in the day-to-day management of projects."

EPRI–DOE jointly funded research efforts span the field from coal conversion and energy storage to transmission research, new generating options, and environmental questions.

The two organizations also cooperate in conducting parallel work that is funded separately but managed jointly or coordinated. In this situation EPRI and DOE concentrate their respective funding on different forms of the same technology or on different aspects of a common problem. They keep each other apprised of progress and exchange useful information.

For example, in the solar area both EPRI and DOE are funding development of central receivers that sit atop so-called power towers, capture the sun's rays, and produce electricity. DOE is funding development of one type of receiver that uses water to produce steam and run a turbine, and EPRI is supporting development of another type that uses a gas, such as air or helium, to drive a gas turbine.

Such an arrangement can prove beneficial to the

Now is the critical time for cooperation. We face a trillion dollars of energy investment in the next 25 years. The new methods that will sustain oil and gas availability for some time will depend on what we commit for building in the next 10 years.

consumer on a long-term basis. "I think it's in the nation's interest to keep as many of these options open at least far enough along to make intelligent decisions on where you really want to put the big dollars as you finally move into the home stretch of commercialization," says Richard Balzhiser, EPRI's vice president for R&D.

"Parallel lines or competitive lines for a similar end are desirable in research, development, and demonstration," insists EPRI President Floyd Culler. "It is usually better to have two competing systems because the probability of any single one failing is reasonably high. Each effort learns from the other in fundamental and practical ways."

EPRI and DOE are also learning from each other's parallel efforts on the health effects of electric fields from high-voltage transmission lines. At Battelle, Pacific Northwest Laboratories in Hanford, Washington, EPRI is funding a project to study such effects on large mammals—the Hanford miniature swine. DOE, at the same location, is studying electric field effects on smaller animals—rats and mice. "They are companion pieces," notes F. F. Parry, director of DOE's Electric Energy Systems Division.

EPRI and DOE cooperate in yet another sense by sharing facilities and resources. "We have used computers at some of DOE's national laboratories at favorable rates on the understanding that the work we are doing is of interest to DOE and that we will make the results available," explains Saxe. For example, DOE has supplied computer facilities for EPRI's Energy Modeling Forum, which brings model developers and model users together for an exchange of information. The two organizations have also shared data bases in the conservation area.

In 1976 EPRI sponsored a series of tests on the resistance of the walls of auxiliary buildings of nuclear plants to damage from tornado-driven debris. The tests were carried out at the Nevada test site of DOE's Sandia Laboratories and used Sandia's rocket sleds to hurl large objects into reinforced concrete panels.

"We pay for using these facilities," notes Milton Levenson, director of EPRI's Nuclear Power Division. "Nevertheless, it is an advantage to us not to have to pay for building a facility for which we would have only intermittent need."

Information exchange, another form of cooperation between EPRI and DOE, takes place in numerous ways. Officials attend each other's workshops and seminars and, in some cases, project review meetings. Work plans may be exchanged and officials may serve on committees together. Some EPRI officials sit on DOE advisory committees.

EPRI maintains an office in Washington, D.C. "The major function of the Washington Office is to provide for exchange of information and coordination of programs with DOE and other energy research organizations in the Washington community," explains Robert Loftness, director. EPRI's technical divisions have representatives in the Washington Office who maintain close liaison with their counterparts in DOE.

The participation agreement signed last year provides for yet another avenue of information exchange —an annual meeting between the under secretary of DOE and the president of EPRI, or their designees, to discuss the status and progress of respective programs. Last May such a meeting was held at DOE with some 30 representatives from the two organizations.

Why should a private organization like EPRI and a public organization like DOE cooperate in such an extensive manner? What are the benefits and what is the rationale? EPRI and DOE officials point to both the magnitude of the energy problem and a mutuality of interest.

"I think we generally agree that the energy prob-

I don't think there is any conflict between R&D by government in the interest of the energy consumer and R&D by EPRI for utilities in the interest of the electricity consumer. They are one and the same.

lems the nation faces—and more specifically the utilities—are of such magnitude that R&D requires a very large effort," states Balzhiser. "We think that by coordinating our efforts we can produce results that will be a good bit more useful and timely than if we worked independently."

"Now is the critical time for cooperation," notes Culler, pointing specifically to the immense national effort required to demonstrate and bring to commercialization some of the coal conversion and other technologies that will help relieve the nation's dependence on foreign oil. "We face a trillion dollars of energy investment in the next 25 years. The new methods that will sustain oil and gas availability for some time will depend on what we commit for building in the next 10 years from the private sector, through EPRI, perhaps, and through DOE and other government agencies."

EPRI and DOE officials agree that the two organizations have mutual interests in confronting these energy challenges.

"We're both trying to reach the same kinds of objectives," remarks John Sawhill, DOE's deputy secretary.

Culler observes, "Both groups are interested in the same end—ensuring that there are broad areas of technology developed to provide for continued sources of electricity and energy. I don't think there is any conflict between R&D by government in the interest of the energy consumer and R&D by EPRI for utilities in the interest of the electricity consumer. They are one and the same."

Chauncey Starr, EPRI's vice chairman, describes a natural partnership between EPRI and DOE, one in which the strengths and weaknesses of the two organizations complement each other. "We're not just adding bucks to the DOE program and they're not just adding bucks to our program," he comments. "They bring a different view, a different perspective, and a different way of doing things. We bring in something different also. The result is a combination that is probably stronger in achieving national objectives than if either one of us worked alone."

DOE's Sawhill agrees with this concept. "We each have access to different talents and resources, and to the extent that they can be combined, I believe we will reinforce each other."

Differences between EPRI and DOE include scope, mandate, constituency, extent of resources, and research emphasis. "We may have a broader mandate and look at technologies that are outside the scope of EPRI's interest," says Sawhill.

"The focus of DOE is on the overall fuels market, while ours is the fuel market for electric utilities," notes René Malès, director of EPRI's Energy Analysis and Environment Division. For example, DOE may be involved in research on automotive fuels, whereas EPRI is not.

The differences in scope and mandate reflect to a large extent the difference in the constituencies the two organizations represent. In turn, these differences are reflected in the different strengths the two organizations possess.

"Our interest is the national interest," explains George Fumich, DOE's assistant secretary for fossil energy. "It's quite broad and much more comprehensive [than EPRI's]. We have to make sure that we try to prioritize the taxpayer's dollar and have a well-balanced national program."

As an industry-supported organization, EPRI cannot make that same statement, notes Chauncey Starr. "EPRI is not really in a position to represent the broad spectrum of national interest," he explains. "We're not a credible agency from that point of view."

Certain initiatives or programs that require national interest for their justification are therefore more appropriately the domain of DOE, which has "an avenue of input to the political process," according to Richard Rudman, director of EPRI's Policy Planning Division. One such example is nuclear waste disposal

We're not just adding bucks to the DOE program and they're not just adding bucks to our program. They bring a different view, a different perspective, and a different way of doing things. The result is a combination that is probably stronger in achieving national objectives than if either one of us worked alone.

and the siting of nuclear waste repositories.

DOE's national interest perspective may lead to greater public acceptance of its actions in some areas. DOE's Parry translates this into a public perception of objectivity.

"Objectivity is the key here," he notes, specifically referring to work on the health effects of electricity production. "It's not that EPRI or General Electric or Westinghouse or the utilities wouldn't do it objectively. It's just that they wouldn't be viewed as doing it objectively."

EPRI's constituency is the electric utility industry directly and the utility ratepayers indirectly. "We come at R&D from the point of view of the utility," notes Balzhiser.

Saxe underlines EPRI's sensitivity to the operating requirements of the industry and says that this is continually sharpened by EPRI's close working relationship with its industry advisory structure.

The utility perspective is named by EPRI officials as perhaps the organization's greatest contribution to its cooperative relationship with DOE. Chauncey Starr, for example, describes EPRI as a vital intermediary step in transferring technology from the laboratory to the end user.

Reflecting on government-industry roles in energy R&D, he comments, "If you look at the energy sector generally and at the electricity sector specifically, what you discover is that the delivery of the energy forms to the end users is handled by nongovernmental groups. It doesn't make any difference whether the resource is oil or gas or electricity or coal. So, in effect, if the government expects the consuming public to get the benefit of government-sponsored research, it really has to go through an intermediary step. Since EPRI exists as a development center for advanced technologies set up by the electric utilities, it becomes very natural for the DOE research activities [on electricity] to work with and pass through EPRI to eventual use."

DOE's Fumich agrees that industry involvement in energy R&D is vital to ensuring that the energy technologies DOE is developing are eventually used in the private sector. Unlike in the space or defense programs, the government will not be the prime mover of energy technologies after development. "In the energy area, we know that private industry will be the driving force," he states. "Unless technology is developed that meets the needs of private industry, we have just wasted critical time and money."

Fumich says DOE looks to industry and industry groups, such as EPRI, for practical guidance throughout the development of a particular technology. "If we start developing something that industry groups don't believe is going to be productive or fit within their scheme of things, they'll tell us early in the game, and we can cut our losses to a minimum. When we start moving down the road with their input—financial and/or professional—we have optimized the chances of developing technology that will in fact pass over into the private sector with the minimum amount of perturbation."

When the opposite is true, Fumich notes, and government funds 100% of a project, manages it on its own, does its own consulting, and gets its own evaluations, "what we usually end up with is a white elephant."

[illegible]

Besides representing different constituencies and perspectives, EPRI and DOE differ in the extent of resources they can draw on for energy R&D. DOE's FY80 budget request is $8.4 billion, with $3.6 billion allotted to energy technology development. EPRI's 1980 R&D budget is $230 million. DOE operates with a staff of 18,000 and, in addition, can call on the "vast facilities and capabilities of the national laboratories," notes David Saxe. EPRI's staff numbers 600.

Although EPRI has fewer financial resources and personnel, it has relative continuity in funding for

I think that someone ought to be worrying about fuels for the twenty-first century, and that's a proper function of government. It's hard to say to a business organization that it should be worrying about that; it's not a business concern, but a broad social question.

specific projects. EPRI officials cite such continuity as one of the organization's important contributions to the national energy R&D picture.

DOE's Parry agrees that this is an advantage for EPRI. "Because the political complexion for the government is changing periodically, programs tend to ebb and flow, whereas EPRI can maintain a more constant level of funding. I think that's a strength for EPRI," he says.

The differences in resources and perspective between the two organizations affect the kinds of research projects they undertake. Variables include cost, level of risk (meaning probability that a project will be successful), and timeframe.

Because of its greater financial resources and its national perspective, DOE can undertake research projects that are higher cost, higher risk, and longer term than those EPRI can support. Chauncey Starr explains why.

"There are those activities that are so far out in time and carry such a magnitude of risk that the electric utility industry would have a hard time justifying any large allocation of its resources to them," he notes. "Take fusion, for example. It's decades away from commercialization, in addition to being very costly and technically high risk. The utility industry can't justify it to its stockholders and consumers. We would be asking consumers of electricity to put large amounts of money into something they may never live to get the benefits of. Yet from the point of view of the nation, there may be some very long-term benefits down the road that the general taxpayer ought to take as a risk and a long-term investment. It becomes the kind of thing that's done for the public good generally." Or as René Malès puts it, something done as a "national insurance policy."

So DOE has taken the lead in funding fusion research in the country. DOE's FY80 budget request for magnetic fusion alone is $364 million, "most of it in large laboratory-type devices," notes Balzhiser, "not in reactors anywhere close to producing power." EPRI's fusion research budget for 1979 was $3.7 million, quite a bit less but a contribution that EPRI officials find valuable from the utility point of view.

EPRI's funds for fusion are used to better define utility requirements for integrating the technology into an operating system. For example, EPRI-sponsored fusion research is examining what it will take to make fusion acceptable to a utility and the fusion options that DOE may not be considering.

Because of its limited financial resources and its responsibility to the utility industry, EPRI has tended toward shorter-term, lower-cost, and lower-risk types of projects.

"Because the utility industry (and therefore to some extent EPRI) has the responsibility to the consumer to keep what we've got operating and reduce the cost," notes Levenson, much of EPRI's program involves projects to improve the reliability, availability, economics, and environmental acceptability of present-day equipment. EPRI officials estimate that 50–60% of their program is devoted to such near-term projects, which they define as research expected to be integrated into a utility system in the next 10 years.

"We lean toward nearer-term programs because that's the area DOE is least able to cope with," comments Rudman. "As we get closer and closer in a timeframe, in-depth knowledge about utility systems is required. That is where EPRI's strength lies."

"As far as maintainability, reliability, and availability questions are concerned, I think the government feels that these are not a governmental concern," notes Saxe. "These are a business concern and I wouldn't argue with that. Similarly, I think that someone ought to be worrying about fuels for the twenty-first century, and that's a proper function of government. It's hard to say to a business organization that it should be worrying about that; it's not a business concern, but a broad social question."

The people are the key. It's the chemistry of the people. They must respect each other and understand their respective strengths and weaknesses in any particular phase of energy development.

Between the two extremes of those very near-term projects involving engineering improvements and the very long-term, large-scale projects involving national laboratories and advanced technologies, there is an area where much of the EPRI–DOE cooperation lies. In this area falls research on coal conversion, energy storage, fuel cells, and many of the other developing technologies that both EPRI and DOE support.

As with any situation in which two different organizations collaborate on specific efforts, there are differences of opinion. Although EPRI and DOE have an extensive, cooperative relationship, that relationship has gone through its zigs and zags, its good days and its bad days. "No affair is ever without its occasional friction," observes Parry, "or it probably wouldn't be working very well."

"We have differences in perspective and viewpoint that make for points of argument and negotiation," says Starr. "But the very differences that create problems make the cooperation worthwhile. To put it in football terms, if everybody on the team was a quarterback, you wouldn't have a very good team. The value of the team is when people supplement one another's strengths in different ways."

EPRI and DOE officials are generally optimistic about cooperation for the future. A firm foundation is built and such formal documents as the participation agreement signed last year serve to foster that relationship. In the final analysis, however, it is the people of both organizations that will make it work.

"The people are the key," says Balzhiser. "It's the chemistry of the people. They must respect each other and understand their respective strengths and weaknesses in any particular phase of energy development."

"It depends on trust," comments Saxe, "trust, respect, and building a reputation for knowing what you're doing and for doing a good job."

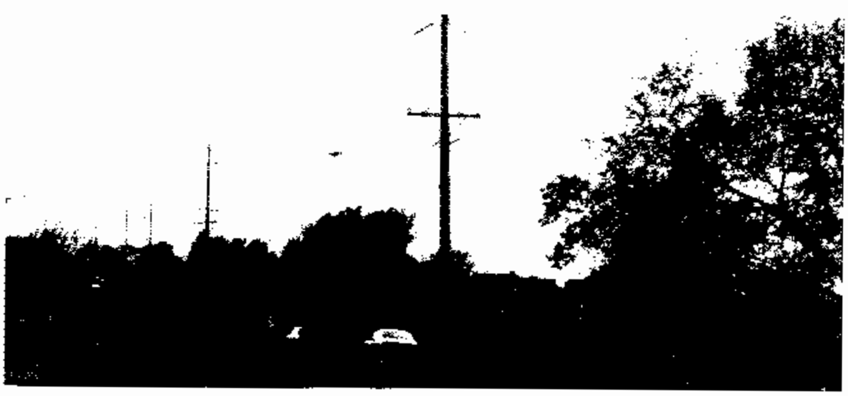
COOPERATION IN ELECTRICAL SYSTEMS

Application Reports Available

In the past three years, the results of over 100 completed EPRI research projects have been adopted by one or more members of the utility industry. These projects are described in the EPRI publication *Research Results and Accomplishments.* Recently, the specific use of 30 of these projects has been discussed with utility users, and efforts have been made to quantify specific benefits. The results of this investigation are available as two-page *Utility Application Reports;* nine of these reports are summarized for this issue. For further information on utility applications of EPRI research, contact Wayne Seden, manager, Research Applications (415-855-2328).

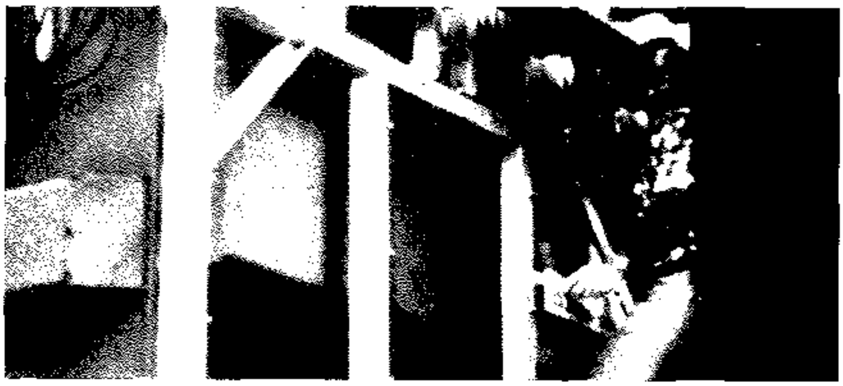
Research Application: 9 Examples in Brief

The dividends of research are frequently elusive. Over the past year efforts have been made to quantify the payback to individual utilities that have applied specific products of EPRI-sponsored research.

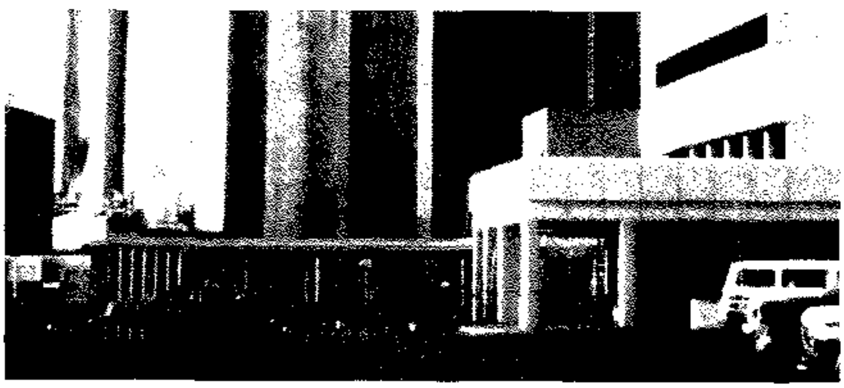


Utah Power & Light Co. applied the compact transmission design developed by Power Technologies, Inc., in residential, commercial, and industrial areas around Salt Lake City, Utah. It used 138-kV lines with 6-ft phase-to-phase spacing in rights-of-way designed for 46-kV and 69-kV transmission. Pole heights were reduced 10–15 ft, leading to a reduced line investment of $4500/mile. (RP260)

Bonneville Power Administration has applied pole inspection and fumigant injection procedures developed by Oregon State University's Forest Research Laboratory to greatly reduce the problem of wood pole decay. To date it has inspected and treated approximately 15,000 power poles with Vapam and estimates this will extend the life of Douglas fir and red cedar poles by 10–15 years. Based on a replacement cost of $1500/pole, BPA estimates annual investment savings of $2,250,000/year. (RP212)



Bonneville Power Administration will apply tuned noise suppression panels designed by Allis-Chalmers Corp. to three transformers at its McLoughlin station (Oregon) in 1980. Demonstrated noise reductions of 12–15 dBa are sufficient to satisfy state noise standards, allowing BPA to defer $4.3 million in capital investment for new transformers until needed replacement in 1986. (RP579)



Consumers Power Co. has used the RETRAN computer program developed by Energy Incorporated to model the transient performance in the steam supply system of its Big Rock nuclear station. Results show that the power output can be safely increased from 220 MW (th) to 240 MW (th). If NRC approves the change in operating limits, the increase in electric power output will be worth an estimated $400,000/year. (RP342, RP889)

Consumers Power Co. used a computer model (POSHO) developed by Scandpower Inc. to predict the probability of fuel rod failure for alternative startup ramp rates at its Palisades nuclear station (cycle-3 fuel). The POSHO code allowed an accelerated rise to power, effectively saving 43 hours of full power, worth an estimated $700,000. (RP509)

Colorado-Ute Electric Association, Inc., relying on tests conducted by Meteorology Research, Inc., at its Nucla station on a 12-MW fabric filter baghouse, found that collection efficiency was higher than for other particulate control technologies and that baghouse reliability approached 100%. Investment savings over electrostatic precipitators were conservatively estimated at \$23–\$37/kW (1980), and CUEA will install a fabric filter baghouse system on its new 400-MW Craig Unit 3. (RP534)

Florida Power & Light Co. has applied jacketed concentric neutral cables developed by General Cable Corp. to its underground distribution system. Neutral corrosion has been reduced, partially offsetting the cost of the semiconductor jacket. Further savings are possible by sharing certain installation costs with communication cables. FP&L, which installs about five million feet of underground distribution cable annually, estimates savings of 2¢ per cable foot from using the jacketed neutral cable in random-lay installations along with telephone lines. (RP671)

Northeast Utilities has used stainless steel alloys resistant to intergranular stress corrosion cracking, together with recommended welding procedures, to avoid cracking in selected areas of the primary piping system of Millstone Unit 1. The utilities hope to save the equivalent of five days' downtime a year through elimination of frequent pipe inspections, representing an annual levelized savings of \$613,000. (RP968)

Tennessee Valley Authority will retrofit 600 MW of its Johnsonville plant with a cocurrent SO_2 scrubbing system. The decision was based primarily on the results of tests conducted on a 1-MW pilot facility at the TVA Colbert plant. Testing of the cocurrent system (gas and slurry traveling in the same direction) points to at least 90% SO_2 removal from the boiler flue gas and distinct advantages over conventional countercurrent scrubbing systems: reductions in the number of scrubber modules as a result of higher flow velocities, plus reduced power requirements and simplified maintenance because of ground level placement of equipment. The cocurrent design will fit more easily into the limited space at the Johnsonville plant, and preliminary estimates indicate a potential annual levelized savings in investment, operation, and maintenance of \$596,000. (RP537)

ELECTRIC POWER RESEARCH INSTITUTE
Post Office Box 10412, Palo Alto, California 94303

NONPROFIT ORGANIZATION
U.S. POSTAGE
PAID
PERMIT NUMBER 7577
SAN FRANCISCO, CALIFORNIA

EPRI

ADDRESS CORRECTION REQUESTED