Report of the Committee on Energy Research and Development

INTRODUCTION

Developments in the area of energy research and development include not only the actions of the Federal Energy Regulatory Commission, the relevant state Public Service Commissions, and the opinions of the courts, but also the attempts of regulators to come to grips with the different character of the object of their regulation, i.e., research and development activities. This year's Committee report covers this broad field of activity by discussing the legal activities and many of the areas where technology development and the law interface.

The first part of this report discusses a decision by the Federal Energy Regulatory Commission ("FERC" or "Commission") which disallowed recovery of costs associated with work in preparation for a coal gasification project and other exploratory projects. While these costs were disallowed, the Commission discussed how future projects could recover their costs. The second part of this report discusses the regulatory problems encountered at the FERC and the California Public Utilities Commission in trying to obtain regulatory approval for the demonstration of a new technology for utilization of geothermal resources. The third part discusses the annual FERC approval of the program and budget for the Gas Research Institute, and the new attitude at the FERC toward its unique responsibility for regulating a research and development organization. Finally, the report discusses the many benefits resulting from the work of the Electric Power Research Institute ("EPRI"). This discussion exhibits the character of the subject matter which should be considered by both state and federal regulators when they seek to determine whether or not members of national research organizations such as EPRI and their customers are receiving sufficient benefits to justify the expenses.

I. DISALLOWANCE OF COSTS FOR ABANDONED GAS RESEARCH AND DEVELOPMENT PROJECTS

In *Natural Gas Pipeline Company of America,* 27 FERC ¶ 61,201 (1984), Opinion No. 218) FERC affirmed in part and modified in part the Initial Decision of the Presiding Administrative Law Judge in denying a request to amortize costs associated with three abandoned gas supply projects — the Dunn County SNG Project, the Kalingas LNG Project, and the Gas Arctic Project. In denying the applications for costs on all three projects the Commission confirmed the policy it would apply in cases where projects are abandoned at an early stage, and the standards to be met in order to receive more favorable treatment by the Commission.

In the Dunn County SNG Project, Natural Gas Pipeline Company of America ("Natural") had planned to build a coal gasification project and to that end had consultants prepare studies for an environmental assessment report. Natural sought to recover approximately $1.5 million in costs incurred in the preparation of these studies, which were of no further use when Natural abandoned the project because of a failure to obtain a required state water permit and other problems. In the Kalingas LNG Project, Natural sought to amortize the $4.5 million it paid to buy

the right to purchase a working interest in a project to produce and liquefy natural gas from offshore Iran. Due to the need for even larger cash commitments and other more attractive alternatives, Natural abandoned this project two years after acquiring its interest and five years before the earliest deliveries could take place. The third project, the Gas Arctic Project, involved Natural's participation as part of a study group which attempted to obtain certificate authorization to transport gas from Prudhoe Bay, Alaska, to the lower 48 states. Natural contributed $6.7 million to the unsuccessful effort, for which it sought amortization approval.

The Commission's denial of Natural's request to be allowed to amortize all of these costs did not result from a lack of perception by the FERC that Natural was trying to alleviate a severe gas shortage. Indeed, the Commission conceded that Natural acted prudently in seeking alternative potential sources to aid its customers. Rather, the Commission's denial of Natural's request was based upon the Commission's determination that, while satisfying the simple test of a prudent expenditure, the Natural Gas Act and FERC precedent requires more. Consistent with that authority, the FERC analyzed that in all three instances the expenses were incurred at such an exceedingly premature stage that the FERC could not justify placing the losses on the ratepayer, rather than Natural's shareholders. The Commission could not find that any of the projects had advanced beyond the level of speculation so that the consumers benefited or could reasonably expect to benefit from the expenditures.

In determining that Natural's expenses did not qualify for amortization, the Commission set guidelines as to the type of evidence a pipeline must provide to secure future FERC approval of similar requests under the prudence standard. First, the pipeline must demonstrate that it alone, and not a related company, provided the funds expended. Second, it must demonstrate that if the project were successful, it would benefit the pipeline's customers and consumers. Third, the pipeline must submit detailed facts demonstrating the degree of planning which went into the project and the assumptions made prior to commitment of funds. Finally, the pipeline should provide evidence of the reasons for abandonment or failure of a project and any efforts to avoid or mitigate the losses resulting therefrom. The Commission felt that these factors would provide the evidence to enable it to determine the reasonableness and prudence of a pipeline's actions in regard to particular projects, which projects must "have been carried beyond the stage of preliminary survey and investigation and where the pipeline's investments are proportionately greater." 27 FERC at p. 61,381.

Opinion No. 218 was sustained by the Commission on a request for rehearing, 28 FERC ¶ 61,020 (1984). The case is currently pending on appeal by Natural in the United States Court of Appeals for the District of Columbia Circuit *Natural Gas Pipeline Co. of America v. FERC,* No. 84-1351. Petitioner's brief has been filed in that docket and respondents brief is currently pending.

II. Regulatory Impediments to Utility Involvement in Research and Development Projects: A Case Study

This is a report of a case study of the regulatory difficulties one group of utilities encountered in attempting to implement a promising geothermal research and

development project. The project was the NORNEV Geothermal Project, a proposed 10-megawatt net binary cycle geothermal generating unit to be located in the Beowawe geothermal field in Nevada.

The project was owned by NORNEV Demonstration Geothermal Company, an Oregon nonprofit cooperative.[1] Because the technology was experimental — it was to involve one of the first applications of a binary cycle geothermal unit — the participants did not expect to reap any "profits" from the enterprise; however, it was hoped that the 15 percent Energy Tax Credit could cut the participants' losses to a tolerable level. That credit was in part dependent upon obtaining "qualifying facility" ("QF") status under Section 210 of the Public Utility Regulatory Policies Act of 1978 ("PURPA"), 16 U.S.C. § 824a-3. Even though four electric utilities were the sponsors, they had reason to expect — or at least to hope for — favorable treatment on the QF issue by FERC, since provisions of the Energy Security Act, 94 Stat. 611 (June 30, 1980), had specifically been drafted in order to allow projects such as NORNEV to achieve QF status. That act, *inter alia,* revised PURPA to allow the FERC to issue regulations granting to utility geothermal small power production facilities of not more than 80 megawatts the benefits of QF status, including qualification as an entity entitled to claim the critical Energy Tax Credit. However, when it promulgated regulations to implement the act, the FERC did not exercise the full scope of its authority; instead, it merely issued regulations which exempt utility geothermal projects from the provisions of the Public Utility Holding Company Act. *See,* 18 C.F.R. § 292.602(b).

In response to the FERC's failure to exercise fully its powers under the Energy Security Act, several applications were filed with FERC. First, on December 28, 1981, NORNEV filed a petition requesting the FERC to disclaim any jurisdiction under Part II of the Federal Power Act over the company. The legal grounds for the petition were straightforward: as a nonprofit cooperative, NORNEV was exempt from Commission economic regulation. *See, Salt River Project Agr. Imp. & Power Dist. v. FPC,* 391 F.d 170 (D.C. Cir.) *cert. denied,* 393 U.S. 857 (1968). Second, early in 1982 NORNEV filed an application for FERC certification as a QF on the grounds that one-half of the ownership interest in NORNEV was owned by municipalities, which are exempt from FERC wholesale rate regulation. Thus, no more than 50 percent of the equity interest in NORNEV was owned by jurisdictional electric utilities, and the QF ownership criteria could therefore be met. Finally, tackling the problem of too-restrictive regulations under the Energy Security Act head-on, PP&L on its own behalf and on behalf of NORNEV filed a petition for amendment of rules, urging that the FERC exercise the full scope of its authority under the Energy Security Act.

None of these efforts bore fruit. Informal indications from the FERC staff are that the FERC is unlikely to disclaim jurisdiction. While the application for QF certification was suspended for a 45-day period in 1981, the FERC has not yet issued a formal order granting — or denying — such status. Finally, a representative of FERC contacted NORNEV in the summer of 1984 to ask whether NORNEV was

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[1]The participants in the project are two investor-owned utilities — Pacific Power & Light Company ("PP&L") and Sierra Pacific Power Company ("Sierra Pacific") — and two publicly-owned utilities — Eugene Water & Electric Board and Sacramento Municipal Utility District.

still interested in pursuing its rulemaking request. NORNEV responded that it was indeed still interested. NORNEV is still waiting.

Not all regulatory difficulties were caused by the FERC. Indeed, the most bizarre application of the regulatory process belongs not to the federal government but to the State of California. The California Public Utilities Commission ("CPUC") has interpreted a provision in state law requiring utilities to obtain certificates of public convenience and necessity prior to building new plant to require *any* utility doing business in California to obtain CPUC approval for any generating project *wherever located.* Because both PP&L and Sierra Pacific have retail customers in California, those utilities were obliged to apply for a California certificate to construct and operate the NORNEV project in Nevada.[2] Fortunately for NORNEV, compliance with this requirement did not prove to be cumbersome.

In part as a consequence of these difficulties, NORNEV's prospects are not bright. That is unfortunate, for it seems manifest that demonstration of alternative generating technologies is in the public interest in order to determine their economic competitiveness with more traditional forms of electric generation. The NORNEV experience suggests that the time has come for a public reexamination of whether utilities should be prohibited from obtaining all the benefits Congress intended when it passed PURPA Section 210. The traditional role of the electric utility industry may require utility participation in the development of alternative generating technologies.

III. Gas Research Institute Annual Funding

The Gas Research Institute ("GRI") is a private, not-for-profit organization established in 1976 and now consists of 223 members of the regulated gas industry. GRI plans, manages, and develops financing for a cooperative research and development ("R&D") program in gaseous fuels and their use. The research program, which is designed to benefit the regulated natural gas industry and gas consumers nationwide, consists of over 300 active research projects in four major areas: supply options, efficient utilization, enhanced service, and fundamental research.

Funding for the GRI program is provided primarily through rates and charges applicable to transportation and sales of natural gas subject to federal or state regulation. On the federal level, an R&D funding unit, approved annually by the FERC in a public procedure using appropriate standards, is incorporated into the cost of gas transported or sold for resale by GRI's 31 interstate pipeline company members and reflected in their rates and charges for natural gas services. The authority of the FERC to continue to approve the GRI program and this surcharge has been built upon four legal and regulatory precepts:

1. *FERC's Preapproval Procedure.* Order No. 566 (Docket No. RM76-17, issued June 3, 1977) provides an advance approval procedure for planned R&D expenditures by jurisdictional natural gas companies, directly or through an R&D organization representing such companies, such as GRI. Pursuant to

[2]Obtaining such a certificate does *not* guarantee that the project costs will be passed along to ratepayers; it merely establishes that it is not illegal for those utilities to proceed with the project.

the guidelines in this order, GRI submits an annual program and budget for approval by the FERC as part of a comprehensive five-year plan to provide continuity from one filing to the next.

2. *GRI as Agent of the Industry.* Since GRI is not a "natural gas company" as defined in the NGA, the FERC's regulations allow GRI to file and to appear before the Commission as the agent of its "natural gas company" members in the annual review process. This concept of GRI as the agent of its regulated pipeline company members has received judicial approval.[3]
3. *Funding for R&D Activities Is Directly Related to Assuring an Adequate and Reliable Supply of Gas at Reasonable Prices.* While GRI's R&D activities themselves are not subject to regulation by the FERC, they are directly related to the FERC's responsibility to assure an adequate and reliable supply of gas at reasonable prices. The authority of the FERC to approve expenditures for these activities was upheld in the *Colorado* case, *supra.*
4. *The Filed Rate Doctrine.* Once the FERC finds the annual GRI funding unit just and reasonable, and approves tariff collection by jurisdictional member pipelines, the funding unit becomes a component of the rate for interstate natural gas service which a state commission must recognize as a reasonable operating expense incurred by the purchasing gas distribution company, *i.e.,* it is in the FERC approved price of gas in interstate commerce. This doctrine is also a basic tenet of the federal regulatory system.[4]

GRI members with significant intrastate gas supplies are also obligated by their GRI membership agreements to seek approval for GRI funding from state regulatory agencies. The outcome of these requests, of course, depends upon the structure of the gas industry in the state and the state laws which regulate that industry.

The FERC has approved the application from GRI every year since 1978.[5] For the 1985 fiscal year, Opinion No. 2126, 28 FERC ¶ 61,386 (1984), approves a 1985 budget for GRI of $132,729,000 and a 1985 funding unit of 1.25 cents per Mcf. The Opinion also approves GRI's five-year 1985-1989 R&D Plan under which GRI expenditures are projected to grow to $206 million and the funding unit to 19.6 mills per Mcf, both in 1985 dollars. The Commission did not accept Staff's report that GRI has not solicited sufficient increased contributions from the intrastate market gas sales and that GRI's projected budget growth rate over the life of the five-year plan is excessive, given the current and anticipated state of the gas industry.

In approving the five-year R&D plan, the Commission made many statements which demonstrate the Commission's belief in GRI's mission. The Commission noted that it has consistently expressed the view in prior Opinions of the absolute

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[3]*Public Utilities Commission of Colorado v. FERC,* 660 F.2d 821 (D.C. Cir. 1981), *cert. denied,* 456 U.S. 944 (1982).

[4]*Montana-Dakota Utilities Company v. Northwestern Public Service Company,* 341 U.S. 246, 71 S. Ct. 692, 95 L.Ed. 912 (1951). See also *Narragansett Electric Company v. Burke,* 381 A.2d 1358 (R.I. Sup. Ct. 1977), *cert. denied,* 435 U.S. 972 (1978).

[5]Opinion No. 195, 25 FERC ¶ 61,147 (1983); Opinion No. 149, 20 FERC ¶ 61,320 (1980); Opinion No. 64, 9 FERC ¶ 61,008 (1979), *aff'd sub nom. Public Utilities Commission of Colorado v. FERC,* 660 F.2d 821 (D.C. Cir. 1981), *cert. denied,* 456 U.S. 944 (1982); Opinion No. 30, 4 FERC ¶ 61,333 (1978).

necessity for R&D in the gas industry. The Commission went on to say, "Given the continuing and permanent uncertainty regarding the future state of gas supplies and the increasing cost to consumers, failure to pursue aggressive R&D in the industry would be disastrous in the long run. The consuming public only stands to gain as such successful R&D permits conservation in supplies and efficiencies in usage. Within this context, we think that as a planning tool the five-year plan proposed is not unreasonable."

This Opinion shows a further maturing of the relationship between the FERC and GRI. The fact that the Commission chose not to become involved in the details of GRI's management activities shows that the Commission is adhering to its original objective, Order No. 566 (Docket No. RM76-17, issued June 3, 1977), of reviewing the GRI plan and program as measured against the FERC's guidelines for R&D organizations, 18 C.F.R. § 154.38(5)(ii). This regulatory approach recognizes the inherent differences between this non-profit research corporation and the more traditional pipelines the FERC is used to regulating.

Commissioner Charles Stalon made a presentation to the 1984 International Gas Research Conference, ("Regulatory Treatment of Research and Development Expenses," given September 11, 1984, Arlington, Virginia) in which he reviewed many of the potential problems a regulatory agency may have in adapting its traditional method of regulating utilities to the task of regulating a research and development program conducted by a non-profit organization.

Specifically, he identified three characteristics of quasi-judicial economic regulatory agencies that do not lend themselves readily to the review of a research and development program: adversarial proceedings, a skeptical attitude toward the applicant, and a tendency to narrowly define costs and benefits. The Commissioner expressed his belief that adversarial proceedings may not be the most effective procedure for bringing expert minds together to distill knowledge previously unknown to anyone. Similarly the skeptical attitude of regulatory agencies, manifested in the assignment of the burden of proof to the applicant/utility, is difficult to translate into a proceeding where the subject matter is a research and development program. Finally, defining costs and benefits in a proceeding involving research results is understandably more difficult since the idea of quantifying these results is open to such controversy.

Commissioner Stalon concluded his remarks by stating that "regulatory agencies are not designed to make good decisions on research funding." While recognizing that the agencies have done reasonably well with existing constraints, he said that, "changes are needed."

It appears from these remarks and Opinion No. 226 that the FERC is attempting to address the inherent differences between GRI and the natural gas companies which it normally regulates. The Commission will not retreat from its statutory requirements to make sure that the funding unit included in the price of gas for resale or transportation services is part of a "just and reasonable" rate. However, if the Commission in the future continues to adhere to its original objective of reviewing the GRI plan and program pursuant to the FERC guidelines, many of the problems discussed by Commissioner Stalon could be avoided. This will ultimately lead to more efficient and effective regulation of GRI as a national research and development organization.

IV. Electric Power Research Institute: a Progress Report

A. *Introduction*

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

EPRI was founded in 1972 as a nonprofit corporation to provide professional planning and management of an industry-wide research and development program. Financial support of EPRI and its programs is furnished by public and private member utilities in proportion to their electricity sales. Together, EPRI's members produce nearly 70 percent of the electricity supplied by U.S. utilities.

B. *Major Research Programs*

Research and development authorized to date reflects a total estimated cost of nearly $4 billion. That circumstance makes it appropriate for EPRI's members, and the public, to question whether such a significant investment is yielding a return in terms of beneficial and significant results of EPRI's research. The following paragraphs represent a sampling of the more significant research programs of EPRI which in 1984 matured to the point that demonstrable value can be ascribed to them.

1. *PCB Management: Finding and Disposing of PCBs*

By far the largest amount of polychlorinated biphenyls (PCBs) still in use remains in equipment owned by electric utilities, which must conform to strict regulations regarding its disposal. Utilities are also responsible for determining possible PCB contamination in as many as 35 million oil-filled transformers and for preventing public exposure to PCBs from the roughly 20,000 transformer leaks that occur each year. EPRI now provides manuals for managing all aspects of PCB detection and disposition, and has sponsored development of a variety of new instruments for measuring PCB contamination. A simple Clor-N-Oil field test kit is now available for screening PCB content of transformer oils. Commercial production of the PCBA-102 gas chromatograph, the first portable instrument for measuring PCB concentration in soils at the site of a transformer leak, also began in late 1984.

2. *High Burnup Fuel: Longer Life for Nuclear Fuel*

EPRI is analyzing and field testing "high burnup" nuclear fuels that can substantially improve plant availability by increasing the time interval between refueling. One example is a fuel assembly containing rods in a 9x9 configuration, instead of the usual 8x8. The rods in the new assembly have smaller diameters and thus generate less heat at their centers. EPRI has also completed a version of the

ESCORE fuel performance code suitable for licensing fuels. Using new fuel designs, an estimated 46 percent of boiling water reactors and 89 percent of pressurized water reactors could increase their average fuel burnup rates by 30 percent.

3. *Reactor Safety: Analysis of Pressurized Thermal Shock*

During the last few years, concern has been expressed over the possibility that introduction of cold emergency cooling water into a hot reactor vessel during a transient event might cause enlargement of existing cracks where the vessel has been embrittled by years of service. Because of this potential safety issue, known as "pressurized thermal shock" (PTS), several utilities have had their pressurized water reactors singled out for possible derating or renovation. In response, EPRI mounted a research program to investigate PTS, which has helped utilities demonstrate that their reactor vessels are, in fact, safe and can be operated for their full design lifetimes. From this research has emerged an integrated set of computer codes and analytical methods that, together with information from a new reactor surveillance data base, can be used to predict accurately the ability of a specific reactor vessel to withstand PTS. Five utilities have so far used these techniques to demonstrate reactor vessel integrity, for potential savings of millions of dollars.

4. *Gasification Combined Cycle: Demonstration of Clean Coal Power*

The 100 MW Cool Water gasification combined cycle (GCC) demonstration plant located in Barstow, California, came on-line in May, 1984, a month ahead of schedule and $31 million (11 percent) under budget. The GCC technology provides a new alternative for burning coal cleanly and economically by first gasifying it and then generating power with a combination of steam turbines and gas turbines. The demonstration plant, now generating power for the Southern California Edison Company system, was constructed with private funding from an international partnership that included EPRI as the major contributor. Initial tests at the plant have confirmed its ability to meet the Nation's strictest emission standards and it has become the first demonstration project to qualify for price supports from the Synthetic Fuels Corporation.

5. *Fuel Cells: Clean Power Plants Downtown*

In order to meet expected demand growth in urban areas beginning in the late 1980s, efforts have been underway for several years to commercialize fuel cell power plants that would be suitable for location in densely populated areas. Since fuel cells convert fuel to electricity directly, without the need for combustion, they produce virtually no air pollutants and can operate with unparallelled efficiency on a variety of fuels. The modular nature of these plants would also allow utilities to add increments of capacity as needed. As part of the on-going commercialization effort, twin 4.8 MW demonstration plants were scheduled for construction in Japan and the United States. The Tokyo plant has been operating successfully since 1983, and based on the success of the Tokyo plant a new

Japanese-American venture company has been formed to build commercial fuel. EPRI is working with utilities in a cooperative effort to install these prototypes.

6. *TLMRF: Testing Transmission Structures*

During its first full year of operation, EPRI's Transmission Line Mechanical Research Facility (TLMRF) has been used to test a variety of existing transmission structures and to conduct research on new structure designs. Results of research at TLMRF are already being used by utilities to upgrade existing lines and to design new transmission structures more cost-effectively.

7. *Transmission Software: Diagnosing Power Line Harmonics*

In order to help utilities diagnose problems caused by harmonics, EPRI has developed a new computer code, HARMFLO, which represents a significant improvement over previous methods of harmonic analysis. The code can model harmonics caused by specified loads, determine how they will propagate, and how harmonics from different sources will interact. The code has already been applied to assess potential effects of a plasma arc heater installation in Minnesota and to locate sources of harmonics interfering with air traffic control radar at the Dallas-Fort Worth Regional Airport.

8. *Reducing Transformer Losses: Amorphous Metal Fabrication*

Because of their fine-grained internal structure, amorphous metals respond more quckly to changing magnetic fields and thus create only about one-quarter of the "no lead" power losses in transformer cores as compared to conventional iron. As a result of research cofunded by EPRI, the first 500 KVA power transformer with a stacked core was constructed in 1984 for delivery to ESEERCO for use on the Niagara Mohawk system. During the year, 25 distribution transformers with wound cores of amorphous steel were also built and are now being field tested. The next step in this program calls for production of 1000 prototype distribution transformers for testing on utility systems.

9. *Generation Planning: Improving Expansion Models*

Changing economic conditions and a widening choice of technological options have made generation expansion planning increasingly complex and costly. Three separate computer programs have traditionally been used in such planning efforts: to calculate generation optimization, production costing, and system reliability, respectively. All three computational tasks can now be handled by a single, EPRI-developed computer code, using a consistent set of data bases and output reports: the Electric Generation Expansion Analysis System (EGEAS). First released in 1983, the EGEAS code has been widely used for such diverse purposes as developing optimal long-range (15 to 20 year) expansion plans, assessing advanced generation technologies, evaluating power sales between neighboring utilities, and studying the sensitivity of expansion plans to changes in various forecasts.

10. *Corporate Planning: A Comprehensive Planning Model*

The new Utility Planning Model (UPM), developed by EPRI and now available through its Electric Power Software Center (EPSC), provides an integrated, long-term corporate planning system. Because UPM is completely integrated, utilities can use it to link supply, demand, financial and regulatory planning. The model can simulate the entire sequence of a utility's functions for periods of 5, 10, 20, or more years. So far the UPM code has been distributed to about 25 utilities, and its application has reportedly saved some users as much as $2-3 million a year in the projected costs of future corporate activities.

11. *Environment: Improving FGD System Availability*

The complex chemical environment inside a coal-fired generating plant's flue gas desulfurization (FGD) equipment eventually leads to corrosion and erosion of key components and linings. Such effects are the leading causes of reduced FGD system availability which, in turn, affects the availability of generating capacity. A comprehensive laboratory and field research program to investigate the problems and identify solutions is helping utilities select the most cost-effective FGD system materials. A new manual on scrubber chemistry control pinpoints the factors that cause high reagent requirements, plugging, and other problems.

12. *Environment: Modeling the Effects of Acid Rain*

A computer model developed as part of EPRI's studies of acidic deposition simulates the movement of water through a lake system and quantifies the processes that can alter watershed acidity. At least six utilities have already used the Integrated Lake Watershed Acidification Study (ILWAS) model to assess the effects of acidic deposition on surface water pH in specific areas, as well as to guide broader related research on ecosystem effects.

13. *Fuels: Expanding the Coal Cleaning Data Base*

The Coal Cleaning Test Facility (CCTF) in Homer City, Pennsylvania, continued to advance the state of the art in 1984, characterizing the cleanability of eight types of coal. Coal analyses allow utilities to design more effective coal cleaning plants, operate existing plants more efficiently, and made sound technical decisions about coal quality and combustion.

14. *Fuels: Coal Slurry Test Burn Completed*

Coal-water slurry, a proven substitute for fuel oil, was successfully test-fired using a utility-scale burner developed by Babcock & Wilcox Company with EPRI support. The test, involving 500 tons of 70 percent coal-slurry, demonstrated slurry firing in a burner with size and performance characteristics typical of, or better than, conventional pulverized-coal burners. The burner demonstration, combined with the results of similar tests by other companies, sets the stage for a prolonged,

full-scale utility plant demonstration that will confirm coal-water slurry's commercial readiness as a boiler fuel.

15. *Generation: Improving Power Plant Performance*

In the past year, numerous products for enhancing the performance of conventional power plants have been completed. These include a manual on chemical cleaning techniques for fossil-fuel boilers and other equipment. A manual on boiler tube failure helps plant operators prevent incipient tube cracking and an acoustic detector has been developed for finding small leaks before more severe failure occurs. New methods for evaluating the remaining life of dissimilar metal welds have become important tools for plant life extension. For both fossil-fuel and nuclear plants, the Modular Modeling System computer code can simulate the dynamic behavior of entire plants or subsystems under a variety of conditions. For boiling water reactor plants, a new fuel support piece grappling device is expected to help reduce refueling outage time through more efficient control blade transfer or replacement.

16. *Generation: Demonstrating Fluidized-Bed Combustion*

Three utility-scale demonstrations of one of the keystone clean-coal technologies for the future, fluidized-bed combustion (FBC), were initiated in 1984 with EPRI support. The demonstration plants will be operting by the end of this decade, providing the technical and economic bases for large-scale commercial application of FBC utility systems.

17. *Energy Management and Conservation: Advanced Batteries for Energy Storage*

The first advanced battery system built expressly for utility load-leveling was installed in EPRI's Battery Energy Storage Test Facility in New Jersey. Ongoing tests will determine reliability, operating constraints, and maintenance requirements of the 500 KWH zinc chloride battery system. Designed for long life and low materials cost, advanced load-leveling batteries could someday help utilities avoid the need for costly peak generating capacity.

18. *Energy Management and Conservation: Guides for Demand-Side Planning*

The specific value to a utility and its ratepayers of such planning depends strongly on local and regional economic, demographic, and geographic factors. Until recently, it was necessary for utilities independently to assess these factors and to select the best mix of demand-side options. Now, a systematic approach to demand planning is available in the form of a series of EPRI guidebooks. The guides cover all aspects of demand-side management, from planning and evaluation to implementation and monitoring. The guides form a unified framework for assessing the diverse elements of demand-side management.

19. *Analysis and Planning: Validated Transfer Model Parameters*

When utilities plan new programs in demand-side management, they often seek to draw upon the experience of other utilities with similar existing programs for the estimation of load impacts. But differences in fuel prices, electricity prices, service area demographics, and weather can greatly complicate the transfer of program results from one utility to others. A group of EPRI projects have dealt with the transferability of the results of demand-side programs. Parameters of a transfer model have been estimated and validated for conservation programs, residential end-use forecasts, and customer response to time-of-use rates. EPRI's work indicates that estimates of customer response to such programs can be reliably transferred if proper allowance is made for the key variables. Thus, utilities can benefit from the experience of other utilities and can design demand-side management strategies with a reasonable expectation of reliable results while minimizing the costly analysis required for a specific service area.

V. Conclusion

As society and the economy become technologically more advanced and complex, so too does the provision of energy. That thought may suggest that successful research and development relating to electric power and other forms of energy represent objectives which, as the frontier of technology advances, can never be fully achieved. Nonetheless, the developments described in the preceding paragraphs represent the effective resolution of serious issues. They are accomplishments of demonstrable value and benefit from a national program of research for the regulated electric utility industry. These products and services must be examined when evaluating such programs.