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## Vital Issues Report
## U.S. Electricity Sector

# Emerging Critical Issues and Technology Needs

## A Vital Issues Panel Sponsored by Sandia National Laboratories, April 1997

Dan E. Arvizu, Arnold B. Baker

Prepared by
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**April 1997**

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**Arnold B. Baker**

## ABSTRACT

In April 1997, a panel of experts representing private sector electricity companies met to identify emerging critical issues in the electricity sector and to ascertain how technology can help with these issues. Sandia National Laboratories sponsored and conducted the meeting. The panel determined the top eight issues that will be critically important over the next five to ten years, when the electricity sector is expected to undergo a major transition in its market and the regulations that govern it. This report presents a discussion of the selection and ranking of critical issues identified by the panel and the research priorities that were identified.

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APPENDICES

# EXECUTIVE SUMMARY

In April 1997, a panel of experts representing private sector electricity companies met to identify emerging critical issues in the electricity sector and to ascertain how technology can help mitigate them. Sandia National Laboratories sponsored and conducted the meeting.

The panel determined that the following issues will be critically important over the next five to ten years, when the electricity sector is expected to undergo a major transition in its market and the regulations that govern it. In priority order, the issues are

- Management and ownership of data streams
- The importance of consumer choice
- Competitive market pricing systems that will determine mix of options
- Environmental issues
- State/federal role in collaborative and strategic research
- Integration of the national electric grid
- Incentives for keeping distribution systems up to date
- Accelerated retirement of a significant amount of generating capacity

Numerical priorities for both the public and private sectors were developed for each of these potential research areas. Federal priorities were highest in the national transmission grid and the environment, where much benefit from public/private sector collaboration can be gained, and private research priorities ranked highest in consumer choice and management of data, where private competitive advantage may be gained.

The detailed discussions that led to the selection and ranking of critical issues and of federal and private research priorities are summarized in the body of this report.

# I. INTRODUCTION

## BACKGROUND

Sandia National Laboratories, as a multi-program laboratory for the U.S. Department of Energy, is actively engaged in assessing the role of technology in meeting emerging critical issues in the electric utility sector. The assessment is needed because the structure of the electricity industry and its regulatory framework are in the process of significant change. Although many aspects of this change are uncertain, there is a strong consensus among industry observers that competition will intensify on many levels, and downward pressure on private utility research and development budgets could occur.

Sandia's initial assessment has three objectives. First, it will identify and prioritize which issues are deemed to be most critical by private sector electric utilities over the next five to ten years of the emerging competitive environment. Second, it will identify those high priority issues that may benefit from technology development. And third, it will offer a suggested private-sector prioritization of related research and development investments for both the public and private sectors. It is hoped that this information will help both public and private decision-makers as they deliberate public policy and research and development investment needs and responsibilities in the electricity sector.

As a part of a multi-faceted exploratory research program, a Vital Issues Panel workshop was held on April 9, 1997, in Albuquerque, NM. The workshop was organized and sponsored by Sandia National Laboratories, and was facilitated by Ecological Planning and Toxicology, Inc. It may be followed by interviews with additional electric utility executives and other experts, and possibly by additional workshops to broaden and increase the validity of the results.

A meeting agenda and list of those attending are attached as Appendix A.

## THE VITAL ISSUES PROCESS

The Vital Issues Process (VIP) is a strategic planning tool developed at Sandia National Laboratories to identify the important elements associated with structuring a portfolio of programmatic items, issues, or other activities for an organization using a facilitated discussion and element ranking by a panel of expert stakeholders.

Vital Issues panels are convened for one- to two-day sessions designed to integrate both qualitative and quantitative approaches to information management. The process unfolds as follows:

- A constructive or qualitative phase.

- The panel synthesizes the definition and scope of its topic and related issues through the development of consensus. Interaction is guided in a manner designed to unlock traditional paradigms and preconceived notions, possibly generating new perspectives.
- An analytical phase. Quantitative methods are applied to perform a trade-off analysis of options. The list of programmatic options is subjected to a quantitative evaluation based on pair-wise comparisons, in which elements are relatively ranked from 1 to 5. In addition, other numeric ranking mechanisms may be used. (See Appendix B for a detailed discussion of the process.)

## PANELISTS

For this Vital Issues Process, a panel of experts was drawn from private electricity companies to provide a range of different perspectives on emerging critical issues and technology needs. By design, the panel was limited to the private sector to concentrate on and better understand its needs and concerns. A list of panelists and their affiliations is attached in Appendix A.

## PREPATORY MATERIAL

Prior to the meeting, panelists were sent background and introductory materials, including meeting objectives, possible dimensions of the new electricity arena, and possible critical technology development and research needs that might arise in that arena to help set the stage for initial discussions. These materials are attached as Appendix C.

## BACKGROUND PRESENTATIONS

Following welcoming remarks by Sandia representatives, the facilitator provided an overview of the purpose and approach for this panel. In addition, as a starting point to generate discussion, she offered introductory comments on some possible dimensions of change in the new electricity arena, possible issues associated with change, possible technology and R&D needs and an explanation of the pair-wise ranking process. These background items are provided in Appendix D.

## ORGANIZATION OF THIS REPORT

The remainder of this report describes the results of this panel's deliberations. It attempts to accurately reflect comments and discussion by participants, but it does not necessarily represent consensus on all issues. The bottom line results and conclusions are presented first for both emerging critical issues and research needs. This section is followed by a discussion of each

critical issue, which, in turn, is followed by a discussion of the role of research and technology development. The final section summarizes the general discussion surrounding issue selection and industry concerns.

# II. RESULTS OF PANEL DISCUSSIONS

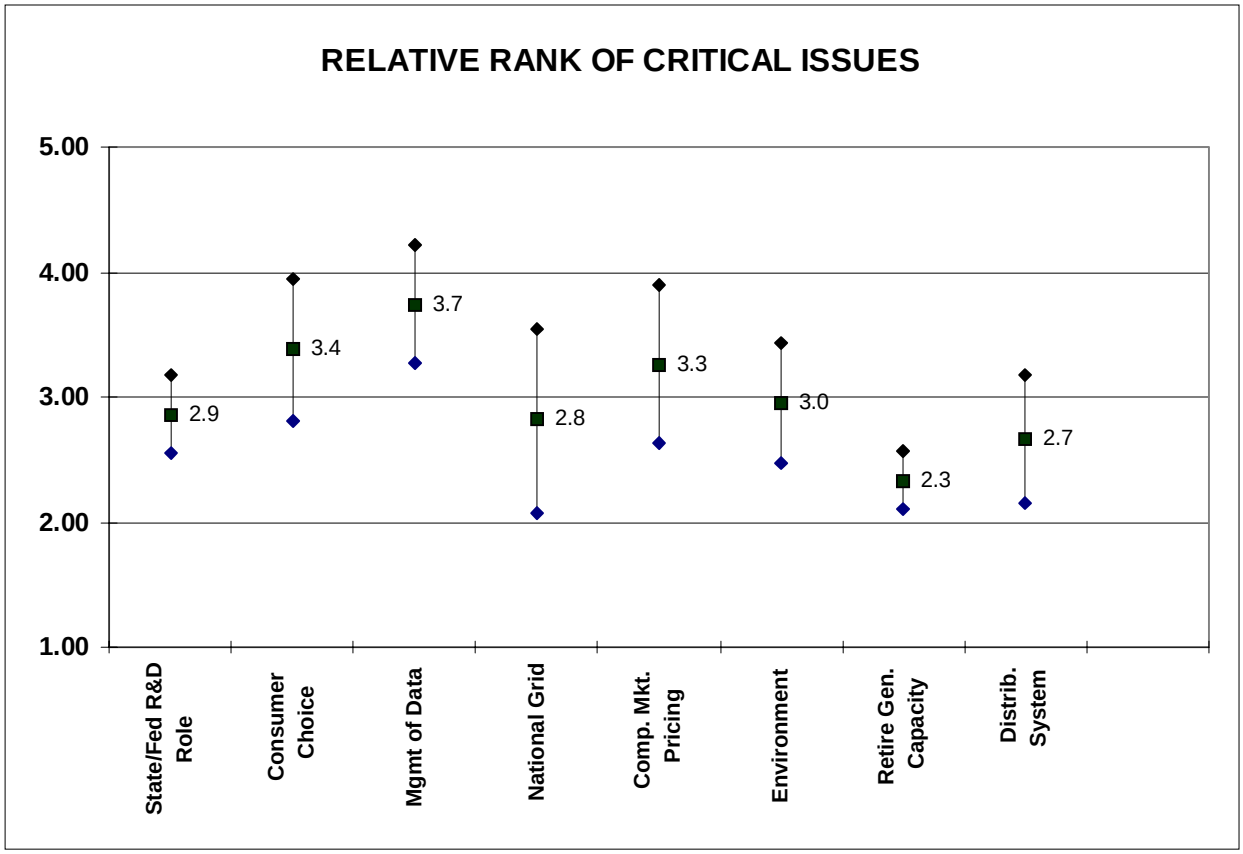
## EMERGING CRITICAL ISSUES

After extensive deliberations, the panel agreed that the following emerging critical issues are important to the future of the electricity industry and will have significant impact on the industry over the next 5 to 10 years as electricity markets change.

- State/federal role in collaborative and strategic research
- The importance of consumer choice
- Management and ownership of data streams
- Integration of the national electric grid
- Competitive market pricing systems that will determine mix of options
- Environmental issues
- Accelerated retirement of a significant amount of generating capacity
- Incentives for keeping distribution systems up to date

### Ranking of Critical Issues

The panel members ranked these issues on a relative scale of 1 to 5 using pair-wise ranking. A 5 was much greater in relative importance and a 1 was much less in relative importance, with 3 having equal importance to the other issues. These results are shown below and are indicative, rather than predictive as a true statistical sample would be. The square indicates the mean relative value, while the diamonds indicate the standard deviation around the mean (the amount of disagreement among the panelists on the relative ranking).




Overall over the next five to 10 years, issues associated with the management of data ranked highest in terms of importance to the electricity industry, while consumer choice and competitive market pricing ranked a close second and third. Concerns with accelerated retirement of generating capacity ranked last, with other issues closely clustered in the moderately important region. It is useful to note that there was a good deal of overlap in the standard deviation ranges of most of the issues, and all but two of them cut across the 3.0 line of equal importance.

## THE ROLE OF RESEARCH AND TECHNOLOGY DEVELOPMENT

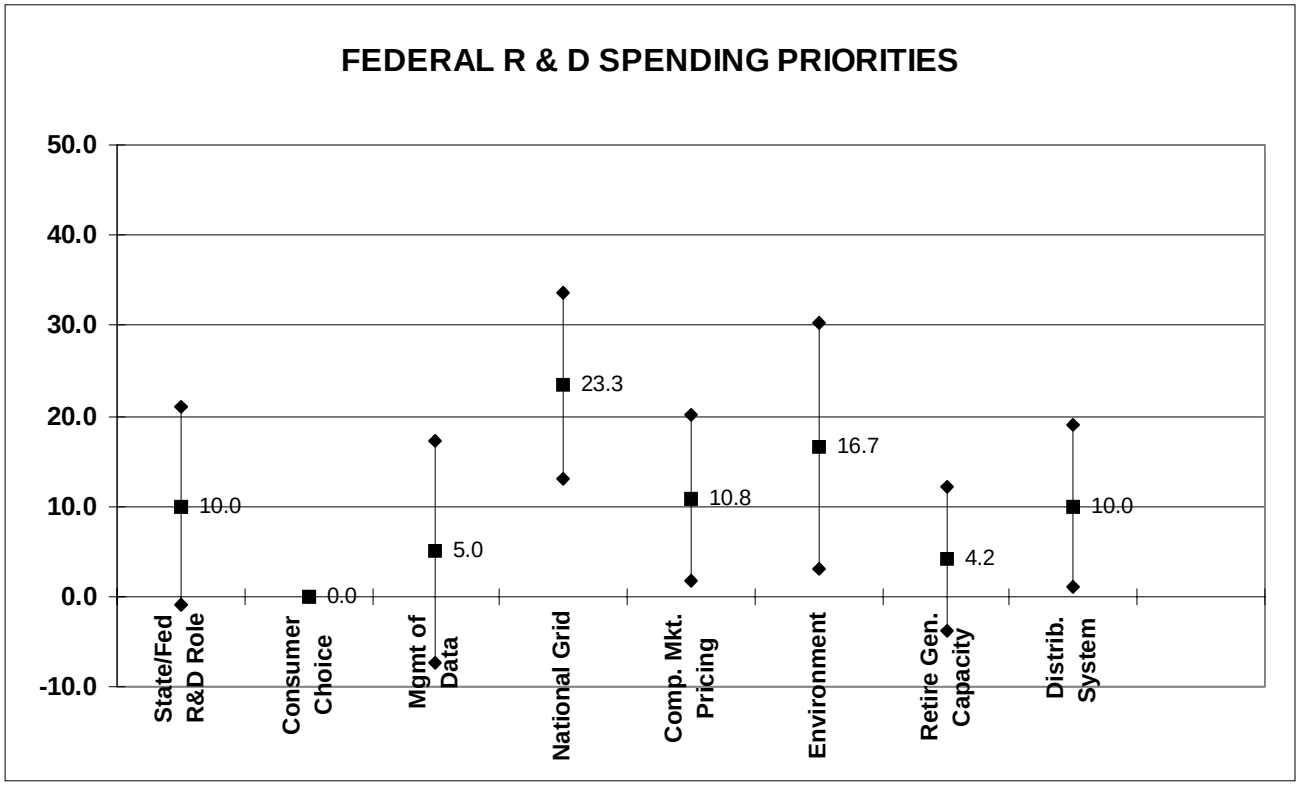
Priorities for these eight critical issues differ for federal and private research. According to this panel, federal priorities should focus on strategic research, the national transmission grid and the environment, where there is much benefit to be gained from public/private sector collaboration, while private research priorities should focus on consumer choice and management of data, where private competitive advantage is likely to be gained.

Research on issues related to the accelerated retirement of generating capacity ranked relatively low in importance in both sectors, while research on incentives for keeping the distribution system up to date and competitive market pricing systems were in the moderately important rank in both sectors. Research related to the state/federal role in collaborative and strategic research ranked moderately in the federal sector, but was judged of very low importance in the private sector.

These conclusions should be interpreted as indicative, rather than predictive. Further, these issue categories are not absolute nor mutually exclusive.

**Ranking of Research Priorities: Federal Spending**

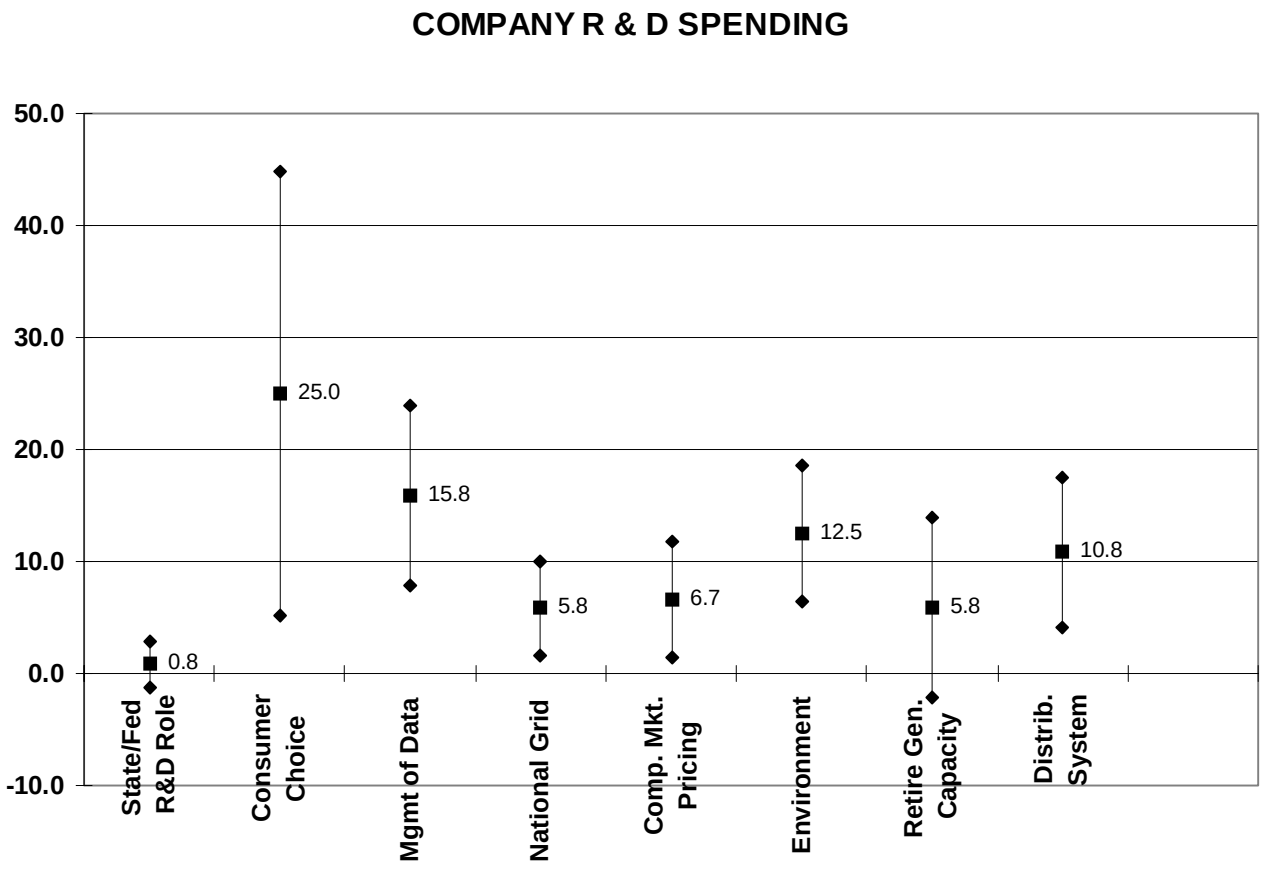
Panelists discussed how research might be directed toward developing technology that would be of assistance in dealing with these emerging critical issues. Following discussion, they were each given a budget of $80 and asked to allocate this money as if they were the federal government (or as if they were providing a recommendation to the federal government on how the federal government should allocate this money). Since there are eight critical issues, if research were equally important to each, each would receive $10. The results are presented below. The squares denote mean values and the diamonds denote one standard deviation from the mean.



The panelists felt that the national electric transmission grid should receive the highest priority for federal R&D expenditures, followed by the environmental area. Accelerated retirement of generation capacity, management of data and consumer choice received very little or no recommended federal R&D spending. Panel members generally felt private sector investment would take care of the last two concerns. The state/federal R&D role, competitive market pricing and distribution system issues each received about one eighth of the panel's federal R&D budget. Note that many of these categories had very wide standard deviations, indicating a large amount of disagreement among the panelists as to the ranking.

## Ranking of Research Priorities: Company R&D Spending

The panel was asked to allocate an $80 budget to these eight categories from the perspective of their current role in private sector electric utilities. The results are noted below, with, again, the square denoting mean values and the diamonds one standard deviation from the mean.



Consumer choice received the highest priority for private company R&D funds (though there was panel disagreement as to ranking), followed by management of data at about a third lower level. Environment and distribution systems ranked about half as high as consumer choice for R&D spending. The other categories ranked relatively low.

# III. DISCUSSION OF CRITICAL ISSUES

The background discussion for each of the eight critical issues is noted below.

## STATE/FEDERAL ROLE IN COLLABORATIVE AND STRATEGIC RESEARCH: Summary of Discussion

How research money will be raised for the industry (wire charges and/or other assessments) and what role the federal government will play in research vis-à-vis the states is yet to be determined. While there is a role for the states, there was strong sentiment that it would be a mistake to try to satisfy national-level public-purpose interests through 50 disjointed state programs. If there is to be a transmission and distribution wires charge, there should be no role for state-led programs. It was felt that involving states was inefficient and could cause the U.S. to lose some of its international competitiveness, since the states would be competing with each other as well as with foreign countries.

A new approach may be needed for federal R&D, perhaps with an advisory structure. The Electric Power Research Institute (EPRI), the national labs, and the federal government should continue to play a role. But some changes will be needed, especially to respond to the new competitive environment and the shift in responsibility from rate payer to investor for some research functions. Industry members will want to focus on a different set of issues than the federal government. And the federal government will need to decide if electricity industry R&D is "on budget" or "off budget." Furthermore, industry does not want to see a federal program telling it what will be done and financed with an industry tax.

Any federal research should concern itself with national and strategic issues, not state issues or projects. R&D needs to be responsive to the specific needs of its customers, and an accountability factor needs to be built into whatever research regime is set up. This will be particularly important if research is financed with a wires charge that is thrown into a large pot. The utility industry does not want this approach to simply turn into another tax, because any long-term research project tends to build its own vested interests, and it is hard to terminate projects that are no longer beneficial.

The correct structural approach is not presently clear, but management of research has to be responsive and needs acceptance and support from its customers. The people who are paying for the research have the greatest interest in seeing it well managed and leading to successful outcomes.

There is some role for government, and with a national grid, independent system operators and EPRI will be part of collaborative efforts. The federal government should play a role in long-term, high-risk research, in part because utilities cannot afford to do so. The federal government also should help establish collaborative research portfolios involving EPRI, the utilities, national

labs, universities and others. Each research organization should focus on what it does well.

## THE IMPORTANCE OF CONSUMER CHOICE: Summary of Discussion

The crux of the new business environment is giving choice to consumers. Traditionally, the only real choice electricity consumers have is whether to turn their light switch on or off. In the new electricity market, consumers will face a significantly expanded set of choices including their electricity supplier and whether to buy and pay a premium for "green power" or other services, much like the call waiting and touch tone options they have on their telephone lines.

Successful utilities will need to know what their customers want and how to provide it. Some competitors are or shortly will be seeking to differentiate themselves through issues such as quality, reliability, customer service, and even local control. Price appears to be emerging as the critical choice variable, but depending on how deregulation affects customer, power quality and reliability could increase in importance.

## MANAGEMENT AND OWNERSHIP OF DATA STREAMS: Summary of Discussion

In a competitive marketplace, there is a strong need for communications. Multiple parties (including distribution companies, marketing companies, billing services, etc.) need access to different parts of the same data pool, including transmission data, which are not proprietary, and customer load profiles, which are. This is similar to the airlines, which must share some data yet compete at the customer interface and keep customer profile data proprietary. There are also similarities with automated banking machines, which different banks need to access, but only in a limited way. And as with banks, security of the data at the meter will be an important issue.

Real questions will arise about who owns the meter (point of presence), who owns the proprietary customer data that comes through the meter, who owns the appliance load data in a private residence, and what is owned by the local distribution company and by the energy supplier. Other questions are suggested, such as what open-architecture communication is needed upstream of the meter gateway, how this will happen, and who will determine the specifications. Gateway architectures and meter technologies are being developed by the competitive marketplace; will they be considered proprietary and who will set any required standards? Will they connect through the Internet, and if so, will the Internet have adequate capacity and how will security be provided?

## INTEGRATION OF THE NATIONAL ELECTRIC GRID, INCLUDING CHANGES IN POWER FLOW: Summary of Discussion

A reliable national electric grid is needed for a truly competitive national electric system. Some entity with national responsibilities needs to make sure that electricity bought in one region gets delivered to another. It may be the case that as the wholesale market for electricity expands, the market will demand a national grid. Expectations are that research will be needed to more efficiently operate the grid, perhaps at near its maximum capacity. But we don't know that for sure. Right now, for example, New England is dealing with different issues than California. Without such a national grid, different state regulatory systems could raise real impediments to a well-functioning electricity market.

Who will have the overall responsibility for operation, maintenance and expansion or contraction in response to regional economic and population changes over time? How will transmission metering be handled, and by whom? Also, protection and protocols will need to be established through consistent regulations, and compliance with consistent enforcement standards must be assured. What part will the reliability councils play in the national grid system? Regional planning groups will be needed, and transmission planning will have to be done in conjunction with utilities.

These issues affect the nation and suggest a key role for the federal government in addressing reliability and stability, and in dealing with the issue of a national grid.

## COMPETITIVE MARKET PRICING SYSTEMS THAT WILL DETERMINE THE MIX OF OPTIONS: Summary of Discussion

Pricing signals will be the main driver in the new electricity market and will direct resources to electricity generation and the end-use consumer, including fuel choice. In the past, the market drivers were public policy and allowable regulated cost.

How comfortable will policy-makers be with the electricity system, including fuel diversity, driven by price and market forces? How will this affect the relationship of base, intermediate, and peaking generating capacity and fuel choice? How well will short-term competitive-performance pressures and new, longer term market signaling mechanisms, such as electricity futures markets, replace traditional public utility commission processes for long-term planning and base-load building, and fit with public expectations for service? How will this system account for social good?

## ENVIRONMENTAL ISSUES: Summary of Discussion

Important local environmental issues (air, water and ground) and global environmental issues (such as prospects for global climate change from fossil fuel carbon dioxide emissions) will continue to affect the industry in the future. These concerns affect where new plants and transmission lines will be located through control of permits and rights-of-way, as well as possible fuel choices for electricity generation over the long term. Such issues will be of particular concern toward the end of the next 5-10 years, when U.S. generation capacity is expected to tighten. Particularly important is who will control these processes in the new competitive environment and with an integrated national grid.

## ACCELERATED RETIREMENT OF A SIGNIFICANT AMOUNT OF GENERATING CAPACITY: Summary of Discussion

The shift to a competitive market may accelerate the retirement of a significant amount of non-economic nuclear and non-nuclear generating capacity. This is in addition to planned nuclear decommissioning, which would affect some 20 percent of current electric generating capacity and is scheduled for the 2005-2020 time frame (though there probably will be extensions of the life of nuclear plants). The impact of such accelerated retirement on base-load capacity and generation fuel mix needs to be considered. In addition, competitive markets will add pressure for improved short-term performance. This could affect relative changes in base, intermediate, and peaking generation capacity, including decisions on plant repowering, since it will increase risk and affect the rate and time profile of return on capacity investment.

## INCENTIVES FOR KEEPING DISTRIBUTION SYSTEMS UP TO DATE: Summary of Discussion

The distribution system will probably be regulated in some way by the state. How will the new competitive environment affect power quality, research related to providing cost-effective electricity distribution systems, and the obligation to serve?

Both good and poor operators will be part of the system. What incentives will there be for distributors to upgrade their system (including appropriate research investments) in a way that is compatible with the national grid? This could pose a problem for energy service companies.

If a utility in one region wants to sell power in another region through the national grid, but the distributor in the delivery region has not added either sufficient capacity or adequate tools in his location, what will happen then? How will state regulatory involvement deal with this, and what role will the federal government have? The observation was made that interstate highways

are always better maintained than city streets. Yet success in the electricity market place will be measured by the weakest link in the system. Though current electricity system models are built around central generation, distributed generation will need to be considered in the future. Some regulatory alliances between local distribution companies, marketers, independent system operators and others will probably be needed.

# IV. THE ROLE OF RESEARCH AND TECHNOLOGY DEVELOPMENT

Panel background discussion on research and technology development needs is noted below by critical issue.

## STATE/FEDERAL ROLE IN COLLABORATIVE AND STRATEGIC RESEARCH: Summary of Discussion

Great concern about how R&D will be funded and directed in the new electricity environment was expressed. For example, wires charges could be the source of R&D money collected by the federal government and/or each of 50 state governments. There was concern that 50 individual state governments making such R&D allocations would dilute and waste research money, spend much of it in unnecessary administrative expenses, and even direct much of it toward state/local projects.

## COMPETITIVE AND COLLABORATIVE RESEARCH: Summary of Discussion

**Importance of Choice; Management and Ownership of Data Streams; Competitive Market Pricing Systems that will Determine the Mix of Options; Environmental Issues; Incentives for Keeping Distribution Systems Up to Date**

Partnering and collaborative research will be key elements of the new environment, and each needs to be undertaken for different purposes. Partnering with non-utility companies in unregulated areas will be used to develop technologies that can enhance competitive positions and contribute to shareholder return on investment for share holders. New players in the emerging competitive environment will seek to differentiate themselves in part through technology innovation. This can come through communications infrastructure or through other competitive differentiation tools, such as competitor analysis systems. Research will need to be directed toward what customers are willing to pay for in terms of what R&D will actually contribute to the bottom line of private companies or meeting the responsibilities of the public sector.

Collaboration with other utilities, government/federal laboratories, and others, on the other hand, will be undertaken in regulated areas such as infrastructure (including independent system operators and grid reliability), environment (including hazardous waste and clean coal) and nuclear safety, which private utilities cannot afford to fund separately. The federal government should provide strong support for environmental R&D, and it should base environmental standards and regulations on sound environmental research.

Private utility environmental R&D will continue, since finding proprietary ways environmental compliance at lower cost can provide a competitive advantage.

Ownership of the intellectual property will be important in setting the research framework. For example, is research in this new environment the property of the rate payer or the investor? If it is the property of the rate payer, then investors will not invest because they cannot earn a return. Who will support research related to the transmission grid?

Private utility research is becoming more and more near-term focused. Before deregulation, R&D normally was a guaranteed recoverable cost in the operating and maintenance rate structure. With deregulation, shareholders, who expect a different return than regulators, may have to pay for R&D. Thus, private electric utility research will be motivated differently and may be substantially reduced. If money is taken from private utilities through wire charges to fund R&D, its benefits should justify its costs. High-risk, longer term research, such as superconductivity, is really the government's role.

There is much less need for collaborative R&D in the distribution system because it is a mature industry and manufacturers will bring those technologies to market.

## NATIONAL GRID TRANSMISSION INTEGRATION, INCLUDING CHANGES IN POWER FLOW: Summary of Discussion

Telecommunications technology is moving so fast that additional electric utility and/or public sector R&D will probably not be needed in consumer end-use meter technology. At the same time, significant R&D will be needed in transmission, and it is expected that a large fraction would be public sector supported. With a national grid, we will need power electronic technologies that we currently don't have, such as powerful high voltage meters. Also, who will integrate, operate, optimize and build transmission lines in a national grid? Today, the system is independently owned, designed and operated. Yet an integrated grid is only as good as the weakest link in any local area. Technologies will be needed to control the system better in the event of a local or regional power failure. Private utilities will need to stay involved in this process, even if a strong government role emerges, since end-use customers most likely will still hold their providing utilities responsible for any problems in the system.

The national grid also will need to deal with power-flow problems that come from supply/demand shifts. With difficulties in getting right-of-way permits for siting new transmission lines, technology should be applied to improve the efficiency of transmission lines and power systems, with building new lines as a last resort. This process will drive distributed electricity generation systems. There also needs to be an adequate return on rate-based regulation for this R&D and to site new lines. In addition, claims made for "green" power may need to be tracked and verified. Transmission lines should be thought of as federal

highways and sited so that individual competitors cannot take unfair advantage of them.

Collaborative R&D in regulated areas has national security as well as economic implications. R&D is needed to allow the transmission system to operate close to maximum capacity. Phase and stability techniques, storage techniques, and high-powered solid-state electronics need to be pursued. Resiliency of the system to weather impacts is important. A reliability issue in the future, military action aside, is terrorism. However, integrating the current different transmission and distribution systems into a national grid may also raise reliability issues. Some of these issues will be regional, which raises a question about how R&D costs, both national and regional, should be allocated to specific regions.

## ACCELERATED RETIREMENT OF A SIGNIFICANT AMOUNT OF GENERATING CAPACITY: Summary of Discussion

A great deal of money has been invested in generation research over the years, and some new technologies are emerging. The focus of generation research in the future, however, should not be on creating more generation choices, but should be on how to use our fossil energy resources in a more environmentally sound, cost-effective and efficient manner. Since new generation plants are cost driven, any research that would lower a company's generation costs would give it a competitive advantage.

In the foreseeable competitive environment, nuclear plants would probably not be built because of regulatory and financial concerns. Repowering techniques are well known, but repowering is done on a case-by-case basis, and basic research is not required. Perhaps some research could be done in combining turbines and fuel cells, if fuel cells became cost-effective. Perhaps a number of small things could be done, but technology does not have a large role here.

There is a role for government research in renewables—for example in reaching long-term goals, such as getting biomass or solar photovoltaics down to commercial rates, though that begs the question whether there is any real interest or need (and by whom) in bringing those costs down. Some of them would probably not exist without federal intervention, though there is social good from these technologies.

On the fuel research side, federal energy policy should not be based on one fuel that might be cheap right now. Rather, a national program of fuel diversity is needed, but instead of developing new fuel technologies, R&D should focus on how to bring the cost of these fuel options down. R&D should also look at nuclear decommissioning, for which a high demand will occur in the 2005-2020 time frame, although the life of nuclear plants will probably be extended. It was felt that decommissioning might lead to increased greenhouse gas emissions,

and during this decommissioning period, world pressure to limit greenhouse gas emissions could be high.

# V. EMERGING BUSINESS ENVIRONMENT: GENERAL DISCUSSION

The general discussion relating to the emerging electricity business environment that was not reported elsewhere in this report is noted below.

The drivers for the electricity business will be different in the future than in the past. For example, how will new base-load generation be built in this new environment? In theory, if the market clearing price is too low, base-load generating capacity may not be built until well after it is really needed. Fortunately, a healthy electric power futures market functioning like the natural gas futures market, coupled with Wall Street-type risk-management tools, should provide adequate market signals as capacity tightens and should reduce the risk of financing new base-load capacity. But the length of time required to site and build new base-load capacity, and the fact that it will be financed by investors, instead of rate payers, could lead to more intermediate and peaking capacity being built. This in turn could affect fuel mix, since new intermediate/peaking capacity is most likely to be natural gas or distillate, while new base-load could be natural gas combined-cycle or coal.

The full ramifications of deregulation are not yet known. It is expected, however, that residential customers will receive an enhanced range of products and services, although the types and prices of products and services could differ between large urban and small rural areas, just as happened with airline deregulation. While deregulation will create much change, it is not likely to cause more dependency on other critical infrastructures such as telecommunications.

Increased public education is needed on environmental impacts and how they are and will be valued in energy market pricing

In the international market, the focus today is on generation, even though the risks of transmission interruption are high, because it is difficult for the host governments to finance generation. Most of the international market today is about risk, price and relationships.

R&D is generally done in the U.S. and then translated into international markets. U.S. utilities should help spearhead an effort to put U.S. technology for energy efficiency into the third world.

Are there technologies being developed in other industries that could significantly affect electric utilities (e.g., communications, fuel cells, etc.)? With rapid changes in some of these areas, the electricity industry needs to re-educate itself every day.

# APPENDIX A

## List of Attendees and Agenda

## ATTENDEE LIST

April 9, 1997
Albuquerque, NM

### PARTICIPANTS

Bijoy Chatt
UtiliCorp United
EnergyOne
Kansas City, MO

Charles H. (Chuck) Huling
Georgia Power Company
A Southern Company
Atlanta, GA

Malcolm W. Jacobson
Enron Corp.
Houston, TX

John W. Neal
National Rural Electric
Cooperative Association
Arlington, VA

Larry Ratliff
Public Service Company
of New Mexico
Albuquerque, NM

James T. Reilly
Southern California Edison
An Edison International Company
Irwindale, CA

### PRODUCTION

Tom Anyos, Consultant
The Technology Group
Atherton, CA

Dan E. Arvizu, Rapporteur
Sandia National Laboratories
Albuquerque, NM

Arnold B. Baker, Rapporteur
Sandia National Laboratories
Albuquerque, NM

Jessica Glicken, Facilitator
Ecological Planning and Toxicology
Albuquerque, NM

# Utility Technology Needs - Vital Issues Panel

## AGENDA

**Hyatt Regency - Enchantment C/D Room**
**Albuquerque, New Mexico**
**April 9, 1997**

| Time | Topic | Principal Discussant(s) |
|---|---|---|
| 8:00 | Welcome | Dan Hartley, Vice President<br>Laboratory Development Division<br>Sandia National Laboratories |
| 8:10 | Meeting Overview | Arnie Baker, Manager<br>Energy Policy & Planning Department<br>Sandia National Laboratories |
| 8:15 | Overview of Vital Issues Process | Jessica Glicken, ep&t |
| 8:30 | Discussion of Key Dimensions of New Electricity Arena | All (facilitated by Glicken) |
| 9:30 | Identification of Emerging Critical Issues of New Electricity Arena | All (facilitated by Glicken) |
| 10:30 | Break | |
| 10:45 | Identification of Emerging Critical Issues of New Electricity Arena (con't) | All (facilitated by Glicken) |
| 12:00 | Lunch | |
| 12:45 | Explanation of Ranking Process | Glicken |
| 1:00 | Ranking of Emerging Issues | All (facilitated by Glicken) |
| 2:30 | Break | |
| 2:45 | Discussion of Issues and Their Amenability to Technology Solutions | All (facilitated by Glicken) |
| 4:15 | Summary and Close | Dan Arvizu, Director<br>Advanced Energy Technology & Policy Center<br>Sandia National Laboratories |
| 4:30 | Adjourn | |
| 5:45 | Van Departs Hyatt for Restaurant | |
| 6:30 | Dinner at Prairie Star Restaurant, Bernalillo | |

*revised April 7, 1997*

# APPENDIX B

## The Vital Issues Process

## The Vital Issues Process

*Identifying Strategic Opportunities:*
*New Strategies for a New World*

### Purpose of the Process

The Vital Issues Process is a strategic planning tool that identifies a portfolio of programmatic activities (an "investment portfolio") for an organization, aimed at satisfying its high-level goals and objectives. The process requires a high level of stakeholder involvement, thus predisposing acceptance of the programmatic endeavors by those stakeholder communities.

### Description of the Process

The Vital Issues Process is multi-staged, involving one or more day-long, intensive workshops, each of which may build on the results of the previous day(s). The first workshop (stage 1) focuses on definitions, identifying target goals and objectives, describing the type of issues or problems addressed by the sponsoring organization, and identifying criteria for selecting issues or problems. The next workshop (stage 2) uses the selection criteria and the definition of the desired issue or problem to identify and rank a set of issues. The following workshop (stage 3) selects one of those identified issues (probably but not necessarily the highest ranked) and identifies and ranks associated programmatic activities. Subsequent workshops can focus on tasks associated with specific programmatic activities.

Because group dynamics constrain the effective size of a panel to no more than twelve participants (with an optimal size of eight to ten), it is possible to run parallel panels on the same topic if the number of stakeholders of constituency groups is greater than twelve.

The panel of participants in each workshop will differ, because expertise will be relevant to the topic at hand. Institutional perspectives key to organizational success should be identified *a priori* and represented on each panel. Each panel also should reflect a broad range of stakeholder communities. Individual panelists should be selected for their expertise and credibility within their professional communities.

### Methodology of the Process

The Vital Issues Process incorporates two primary approaches: a qualitative, or transactional method, which takes a synthesis approach; and a quantitative, or net benefit maximization method, in which some analysis activities are performed. The transactional method involves dialogue among individuals or

groups with some stake in the sponsoring organization's activities. Such dialogue usually focuses on definition of a problem or issue (which can include definition of an organization's goals and objectives) and criteria for measuring success through problem solution or goal achievement. Participation in the construction, or synthesis, of those definitions allows participants to become invested in the process. The definitions constructed by these synthetic activities form the environment within which a set of alternatives (such as issues or programs) can be identified. Net benefit maximization uses quantitative methods to perform a cost/benefit analysis on a set of given alternatives, seeking to identify the alternative that provides the greatest social (or organizational) good according to some set of criteria.

Both methods are applied in each workshop of the Vital Issues Process. The process begins with a discussion of the topical area with which the workshop is charged, seeking to construct a definition that satisfies the group and which sets the parameters within which the specific issues, activities, or tasks are identified. Criteria for measuring success are also identified. Group discussion clarifies the identified issues and leads to consensus on their definition and scope. The issues are then relatively ranked (that is, the items in the set are ranked against each other, and not against any external, absolute standard) using pair-wise comparisons or other ranking methods. Pairwise comparisons compare each issue to all others in the set in turn again each of the identified selection criteria by asking the scorer to assign specific values to each issue. This forces panelists to make explicit the tradeoff process and the criteria by which they are making the tradeoffs.

# APPENDIX C

## Letter of Invitation and Attachments

Sandia National Laboratories

Operated for the U.S. Department of Energy by
**Sandia Corporation**

**Joan B. Woodard**
Vice President
Energy, Environment, and Information Technology Division

Albuquerque, NM 87185-0724
Livermore, CA 94551-0969

Phone: (505)845-9917
(505)845-9918 (Secretary)
Fax: (505)844-6953
Internet: jbwooda@sandia.gov

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Dear

As you know, today's electric utility industry is facing an unprecedented challenge as it restructures and adjusts to a new, uncertain regulatory and competitive business environment. There is concern in many sectors that adequate resources may not be available in either the public or the private sector to meet critical technology needs that might arise in this new world.

Both the new administration in Washington and private sector electricity executives are looking for input to help identify critical technology development needs and how they best might be met. Because of your innovative thinking and recognized industry leadership, we are pleased to invite you to participate on a Vital Issues panel to be held in Albuquerque, New Mexico, on April 9, 1997. At this panel meeting, you and your peers will identify critical areas for technology development in the electricity sector most likely to arise over the next five to ten years. The panel will generate a working paper that can be circulated to key public and private sector technology development decision-makers to help ensure that these needs are met.

At this meeting, you will participate with eight to ten other participants and stakeholders in the emerging electricity market. This panel will focus on clearly identifying, describing, and weighting critical technology development requirements that will emerge in the electricity arena over the next five to ten years as a result of its restructuring.

The host for the panel meeting is Sandia National Laboratories, located in Albuquerque, New Mexico. Sandia is a U.S. Department of Energy multi-program engineering laboratory, born from Cold War needs for nuclear weapons engineering. Over the last 25 years, Sandia has developed a substantial research and technology development program in advanced energy technologies. In fiscal year 1996,

Sandia's energy-related research budget was over $140 million, which leverages the $550 million invested in the advanced science and engineering research related to national security. The energy budget was invested in a number of significant programs in advanced battery technologies, civil nuclear reactor design and safety research, state-of-the-art photovoltaic and solar central receiver technologies, advanced catalysis research, and related areas. These and other key Sandia capabilities, including information technologies, non-hierarchical and hybrid networks, probabilistic risk assessment, pulsed power, microelectronics, virtual reality, power switching, and intelligent sensing can be brought to bear on the electric power industry of the future. You will have an opportunity to tour Sandia's research facilities after the panel meeting.

Our meeting will produce a document containing the following distinct, but interrelated, products:

- a working description of some of the key dimensions of the new electricity arena over the next five to ten years;
- a list of clearly described areas of critical technology development needs; and
- a ranking of the relative importance (a weighting) of these areas.

As food for thought, please consider the following initial discussion parameters. They are intended to stimulate your thinking and to give us a starting point for our conversation.

Over the following five to ten years, we may see:

- significant regulatory and business uncertainty;
- structural integration and disintegration of the electricity business;
- intense competition in electricity generation;
- the internationalization of business;
- emergence of new business organizations offering new kinds of services (e.g., ESCOs); and
- current players competing for new territories.

Critical technology development and research needs that could arise in this environment might include:

- new communications networks;
- new reliability management tools;
- improved network surety options; and
- new competitor analysis and data management tools.

Discussion will focus on the creation of a single list of critical needs acceptable to all participants and the clear description of the needs on the list. Once we agree on the list, we will work through a structured process which uses pair-wise comparisons (see Attachment A) to ascertain the relative importance of the needs. Details on process implementation will be given at the Panel meeting.

**Panelists.** Panel members will be drawn from a range of organizations which have some stake or (potential) role to play in provision or use of technology in the emerging electricity arena. This will include traditional electric utilities as well as potential new players in the electricity market. Our hope is that the broad representation from key players will result in a productive dialogue and in output which can effectively inform public and private sector decision-makers who fund technology development programs

**Panel Output.** To help service the ambitious nature of this Panel meeting, we will have both a facilitator and a *rapporteur*. We will prepare a report of the meeting. Prior to publication of the report, you will have an opportunity to review and comment on its contents.

Attachment B is an agenda for the meeting with some suggestions for preparatory thinking. We look forward to an interesting and productive exchange.

Sincerely,

Attachments

## Attachment A
# Pair-wise Comparisons

The following presents an annotated example of a pair-wise comparisons scoring sheet. The process will be explained in detail at the meeting.

***Example Pair-wise Comparisons Scoring Sheet***

| ***Technology needs*** | *comm. network tools* | *reliability mgmt tools* | *information mgmt. tools* | ***relative value*** |
|---|---|---|---|---|
| *comm. network tools* | * | 5 | 5 | **5** |
| *reliability mgmt. tools* | 1 | * | 4 | **2.5** |
| *information mgmt. tools* | 1 | 2 | * | **1.5** |

Scale: 5 = Much greater importance
4 = Greater importance
3 = Same importance
2 = Less importance
1 = Much less importance

The score sheet is read from left to right - from row to column.

***Interpretation***

According to the example score sheet, *comm. network tools* was judged to be a technology need of much greater importance (score of 5 in first row, second column) than *reliability mgmt. tools*. *Comm. network tools* also was judged to be of much greater importance than *information mgmt. tools* (score of 5 in first row, second column).

*Reliability mgmt. tools* was judged to have much less importance than *comm. network tools* (score of 1 in second row, first column) and more importance (score of 4 in second row, third column) than *information mgmt. tools*.

*Information mgmt. tools* was judged to be much less important than *comm. network tools* (score of 1 in third row, first column) and less important than *reliability mgmt. tools* (score of 2 in third row, second column).

When we compute the weighted or relative value of the technology needs, we find that *comm. network tools* is judged to be much more important (5) than the hypothetical average criterion in this set by the scorer. *Reliability mgmt. tools* was judged to be slightly less than equally as important (2.5) and *information mgmt. tools* close to much less important than the hypothetical average technology need.

# APPENDIX D

## Background:
## Potential Dimensions, Issues, and Technology Needs

## key dimensions of change

- **significant regulatory and business uncertainty;**
- **structural integration and disintegration of the electricity business;**
- **intense competition in electricity generation;**
- **the internationalization of business;**
- **emergence of new business organizations offering new kinds of services (e.g. ESCOs);**
- **current players competing for new territories**
-

## issues associated with change

- **different operational demands imposed by business and regulatory uncertainties**
- **business requirements of new kinds of alliances (e.g. data exchange)**
- **changed locus of responsible for reliability at various points in the grid**
- **changed business requirements of distributed v. centralized systems**
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## technology and R&D needs

- **new communications networks;**
- **new reliability management tools;**
- **improved network surety options;**
- **new competitor analysis and data management tools**
-

## how do these tie to the issues?