THE U.S. NUCLEAR ENERGY INDUSTRY'S

Strategic Plan for Building New Nuclear Power Plants

EXECUTIVE SUMMARY

FINAL REPORT

MAY 1998

THE U.S. NUCLEAR ENERGY INDUSTRY'S
FINAL REPORT
MAY 1998

Strategic Plan for Building New Nuclear Power Plants

NUCLEAR ENERGY INSTITUTE (NEI) EXECUTIVE COMMITTEE

JAMES J. HOWARD
Chairman, President and Chief Executive Officer, Northern States Power Company
Chairman of the Board, Nuclear Energy Institute

RICHARD A. ABDOO
Chairman and Chief Executive Officer, Wisconsin Energy Corporation

WILLIAM CAVANAUGH, III
President and Chief Executive Officer, Carolina Power & Light Company

JOE F. COLVIN
President and Chief Executive Officer, Nuclear Energy Institute

CRAVEN CROWELL
Chairman, Tennessee Valley Authority

W. GEORGE HAIRSTON III
President and Chief Executive Officer, Southern Nuclear Operating Company

WILLIAM F. HECHT
Chairman, President and Chief Executive Officer, PP&L, Inc.

DONALD C. HINTZ
President and Chief Executive Officer, Entergy Operations, Inc.

CORBIN A. MCNEILL, JR.
Chairman, President and Chief Executive Officer, PECO Energy Company

ERLE NYE
Chairman of the Board and Chief Executive, TU Electric

CHRISTIAN H. POINDEXTER
Chairman of the Board and Chief Executive Officer, Baltimore Gas and Electric Company

LOUIS J. SAS
President and Chief Executive Officer, Raytheon Nuclear, Inc.

RICHARD SNELL
Chairman of the Board and Chief Executive Officer, Pinnacle West Capital Corporation

DR. STEVEN R. SPECKER
President, GE Nuclear Energy

Ex-Officio Members of the Executive Committee

GLENN ENGLISH
Executive Vice President and General Manager, National Rural Electric Cooperative Association

THOMAS R. KUHN
President, Edison Electric Institute

DR. JAMES T. RHODES
Chairman and Chief Executive Officer, Institute of Nuclear Power Operations

ALAN RICHARDSON, ESQ.
Executive Director, American Public Power Association

DR. KURT YEAGER
President and Chief Executive Officer, EPRI

MESSAGE FROM THE CHAIRMAN

The Nuclear Power Oversight Committee, comprising the leadership of the nuclear energy industry, issued the first edition of the *Nuclear Energy Industry's Strategic Plan for Building New Nuclear Power Plants* in November 1990. They had an important vision for America. They saw a need to build new nuclear plants in a fundamentally improved way—with improved, standardized designs based on owner-operator requirements, a predictable licensing process, improved plant performance, and enhanced public and political recognition for the importance of nuclear energy to this nation. They created a plan that set specific and challenging milestones to make this vision a reality—then held industry organizations accountable for reaching each milestone.

This strategic plan has accomplished much of what it set out to do and has helped the industry maintain its focus throughout a number of unexpected challenges. In 1990, few could have predicted the decade's new challenges: electric utility restructuring, the low demand for new baseload capacity, the ramp-down of the Department of Energy's funding of nuclear energy research and development, continued delays in federal action to address spent nuclear fuel and low-level waste management issues, and unexpected issues in advanced reactor design approval and certification.

This decade also has brought successes and opportunities for nuclear energy: hard-won and remarkable improvements in U.S. nuclear power plant safety, reliability and economic performance; significant demand for U.S. nuclear technology overseas, including a growing interest in Asia in U.S. advanced light water reactor (ALWR) designs; a growing global awareness of environmental issues that makes nuclear energy an ever more compelling energy option; and the positive impacts of industry restructuring that are improving nuclear energy economics while maintaining high standards of safety.

With completion of the bulk of project-specific milestones and the fundamental changes that are reshaping the U.S. energy marketplace, it is time to bring this strategic plan to a close in favor of an expanded strategic direction for the 21st century. Thus, this is the final report on the strategic plan. A cumulative review of eight years of progress, this report marks both an end and a beginning—the end of a major effort highlighted by many successes and the beginning of an expanded strategic planning direction geared to the challenges of the future. The industry's policy paper, *Nuclear Energy: 2000 and Beyond, A Strategic Direction for Nuclear Energy in the 21st Century*, will be unveiled in conjunction with release of this final report.

Through this strategic plan, the nuclear energy industry has accomplished much. Since the plan was issued, the industry has steadily improved nuclear plant performance. For example, from 1990 to 1997, operating unit capability factors increased from a median of 7l.7 percent to 81.6 percent. Matching this improvement have been equally dramatic gains in safety system performance, as measured by World Association of Nuclear Operators performance indicators. At the same time, average production costs have decreased—from 2.63 cents to 1.91 cents per kilowatt-hour. These significant and steady trends have been impressive—increasing our confidence that improved, standardized nuclear power plants will compete favorably with other electricity generating options.

Congress passed major legislation, the National Energy Policy Act of 1992, which reformed the nuclear plant licensing process, committed $100 million to first-of-a-kind engineering for ALWRs, restructured the uranium enrichment enterprise, and directed improvements in the repository standards for disposal of the nation's spent nuclear fuel.

Key strategic plan milestones have been achieved in several areas of ALWR development:

- ALWR design requirements were developed by utilities, reviewed and approved by the U.S. Nuclear Regulatory Commission, and applied by reactor designers as the bid specification for standardized ALWRs.

- General Electric's 1,350-megawatt Advanced Boiling Water Reactor and ABB Combustion Engineering's 1,350-megawatt System 80+ Standard Plant were approved and certified by the NRC. The NRC is expected to give final design approval to the Westinghouse 600-megawatt AP600 this year, with design certification to follow.

- First-of-a-kind engineering—funded jointly by the Department of Energy at $100 million and by industry at $175 million—has been completed for the ABWR and will be completed in 1998 for the AP600. This work provides essential information for improved certainty in project planning—a high level of engineering design completion and critical data on the schedule and cost of construction. It is already being applied by Taiwan Power Company in the design and construction of two ABWRs at its Lungmen site.

- Two General Electric ABWRs have been built by Tokyo Electric Power Company and are operating in Japan.

Now is the time to move forward and build on these successes. Today nuclear energy:

- supplies one-fifth of the nation's electricity;

- is the largest source of emission-free electricity, avoiding the discharge into the air each year of approximately 150 million metric tons of carbon, 4.8 million metric tons of sulfur dioxide and 2.5 million metric tons of nitrogen oxide;

- is a reliable energy source contributing directly to enhanced energy security and diversity; and

- is the preferred choice for new electric generating capacity by many nations, particularly in Asia.

The unique ability of nuclear power plants to produce reliable baseload electricity without polluting the air makes nuclear an energy option that the world has accepted and the United States cannot ignore.

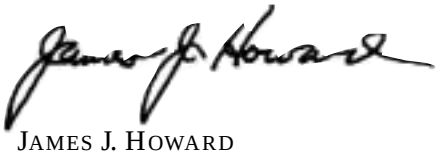
As the environmental and energy policy goals of the nuclear industry and the nation begin to converge, the strategy for the 21st century must be to remove any remaining barriers and economic and political biases against the increased use of nuclear energy. The industry's expanded strategic direction will take up this challenge. It will provide a compelling foundation for ensuring the significant contribution of nuclear energy toward meeting the energy and environmental challenges of the next century, in part by facilitating license renewal for current plants and continuing to pave the way for construction of advanced, NRC-certified nuclear plants when needed in the United States. A key bellwether for new nuclear plant orders will be industry experience with the NRC in renewing the licenses for existing plants. Baltimore Gas and Electric Company's recent application to renew the licenses for its two-unit Calvert Cliffs Nuclear Power Plant is encouraging, and the industry intends to work with the NRC to achieve a license renewal process that is stable, predictable and efficient.

In the Executive Summary of this report, you'll find a more complete list of key activities we intend to pursue, including continued improvement of plant operating and safety performance, pressing the federal government to meet its obligation to accept spent nuclear fuel, ensuring that state and federal policies shaping a restructured electricity industry reflect the vital role of nuclear energy, and continued emphasis on applying spin-off benefits of the ALWR program to improve the safety, reliability and economics of existing plants.

Finally, the nuclear industry will encourage a new commitment to a farsighted national energy strategy—one that acknowledges that nuclear energy is essential to our future, and that invests in energy research and development consistent with that strategy. There is great potential for continued improvements in nuclear technology that will further enhance its safety, reliability and economics, while fulfilling its role as an emission-free source of electricity.

As this strategic plan is closed out, I would like to express special thanks on behalf of the nuclear energy industry for the hard work and dedication of General Electric, ABB Combustion Engineering and Westinghouse personnel involved in the development and certification of the ALWR designs, as well as to utility personnel and the staffs of EPRI, the Institute of Nuclear Power Operations, and NEI toward the goals of this strategic plan. Special thanks are due to Philip Bayne and Joseph Farley for their leadership and insight as past and current chairman of the Ad Hoc Committee on the Strategic Plan, and to John Taylor, R. Patrick McDonald and Edwin Kintner for their vision and tireless efforts to secure the benefits of nuclear energy for future generations of Americans.

Our industry renews its pledge to stay the course set in 1990 and provide the leadership necessary to ensure that the nuclear energy industry is ready to meet the challenges of the 21st century. Recognizing that the challenges ahead cannot be met by industry alone, we look forward to continuing to work with Congress, the administration, and the NRC on actions to maintain and expand the role of nuclear energy.



JAMES J. HOWARD
Chairman, Nuclear Energy Institute
and Chairman, President and
Chief Executive Officer
Northern States Power Company

AD HOC COMMITTEE: THE U.S. NUCLEAR ENERGY INDUSTRY'S STRATEGIC PLAN FOR BUILDING NEW NUCLEAR POWER PLANTS

JOSEPH M. FARLEY, CHAIRMAN
Chairman, Southern Nuclear Operating Company (retired)

HOWARD J. BRUSCHI
Vice President and General Manager, New Plant and Technology,
Westinghouse Electric Company

JOE F. COLVIN
President and Chief Executive Officer, Nuclear Energy Institute

EUGENE E. FITZPATRICK
Executive Vice President, Nuclear Generation, American Electric Power Service Corp.
Chairman of the Advanced Reactor Corporation Utility Management Board

STEVEN A. HUCIK
General Manager, Nuclear Plant Projects, GE Nuclear Energy

ROBIN L. JONES
Vice President, Nuclear Power Group, Electric Power Research Institute

LOUIS B. LONG
Vice President, Technical Services, Southern Nuclear Operating Company

WILLIAM R. MCCOLLUM
Vice President, Duke Power Company

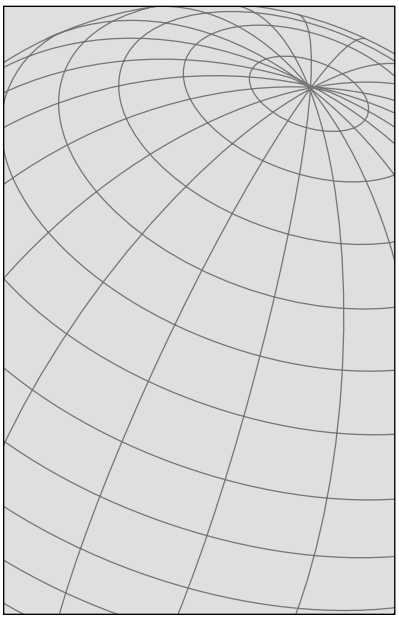
ROBERT E. NEWMAN
President, Nuclear Systems, ABB Combustion Engineering Nuclear Power

ZACK T. PATE
Chairman Emeritus, Institute of Nuclear Power Operations

MICHAEL J. WALLACE
Senior Vice President, Nuclear Strategic Services, Commonwealth Edison Company

FINAL REPORT ON THE
STRATEGIC PLAN
FOR BUILDING
NEW NUCLEAR
POWER PLANTS

SECTION I



EXECUTIVE SUMMARY

SECTION I:

EXECUTIVE SUMMARY

OVERVIEW

In November 1990, the Nuclear Power Oversight Committee (NPOC), comprising the leadership of the nuclear energy industry, initiated this Strategic Plan for Building New Nuclear Power Plants. The plan's goal: to create the enabling conditions under which electric power companies could order new nuclear power plants. NPOC chartered the Ad Hoc Committee on the Strategic Plan to manage and update the plan each year. Since the formation of the Nuclear Energy Institute (NEI) as part of the major industry reorganization in 1994, the strategic plan has been overseen by the NEI Executive Committee.

The concept behind this strategic plan was to integrate the industry's efforts to address the institutional and technical issues on which significant progress must be achieved to make nuclear energy a viable option for the future. This plan:

- identified the significant enabling conditions (technical, regulatory, environmental, financial, legislative, organizational, political and public acceptance) that must be met to achieve the goal.
- assigned responsibilities to the appropriate industry organizations for achieving each enabling condition.
- fostered effective coordination between government and industry that pooled respective expertise and resources to achieve common goals.

This is the final report on the strategic plan. Unlike the annual updates published each year since 1990, this final report reflects the cumulative progress since the plan's inception. The overview in Section II provides a historical perspective and describes the plan's content and how it was implemented, as well as the industry's strong commitment to standardization as a cornerstone of the strategic plan. The plan's enabling conditions—its "building blocks"—are outlined in Figure 1 on page II-3, which shows the industry group that has had primary responsibility for each block. Section III provides final reports on each building block, highlighting the accomplishments achieved since the plan's inception and identifying continuing activities related to completing building block goals.

THE NEED FOR NEW NUCLEAR POWER PLANTS

The transition-in-progress of the highly regulated electric utility industry into a competitive electricity marketplace is fundamentally changing the rules for determining the need for new generating capacity and how that need is to be met. For the next few years, existing generating plants are expected to provide an adequate supply of electricity in most regions of the United States. The electric power industry is significantly improving the output from existing plants, particularly its nuclear units, and is developing a variety of resources—conventional generating capacity (primarily gas turbine),

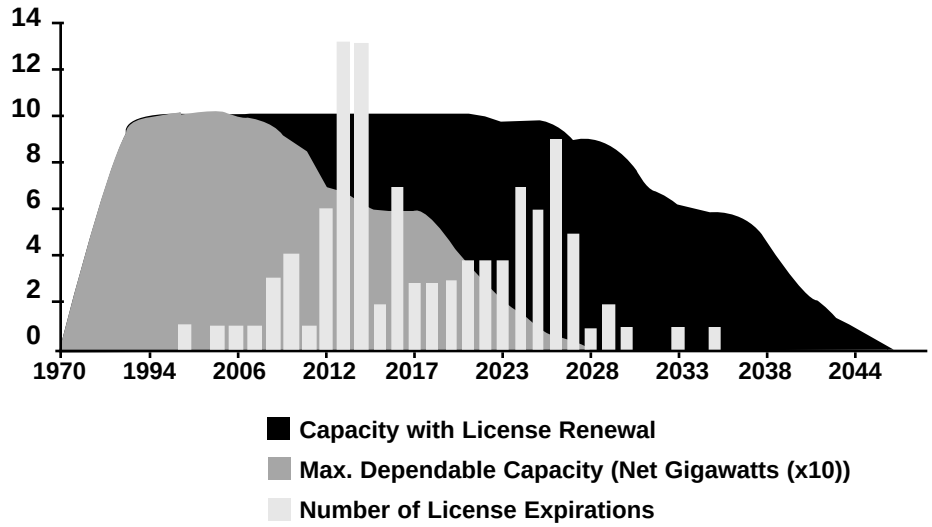
demand-side management, conservation, and non-utility generation—that will support a growth rate in electricity demand of about 2 percent a year. This is within the range of most growth forecasts.

Soon after the turn of the turn of the century, a growing need for new baseload capacity is forecast to replace and augment the aging workhorses of the U.S. electric supply system. In 1970, 83 percent of U.S. baseload power plants were less than 20 years old; only 9 percent were over 30 years old. By 2000, only one-quarter of the baseload power plants will be less than 20 years old, while more than one-third—about 140,000 megawatts—will be over 30 years old. Some of this existing baseload capacity must be replaced as older plants reach the end of their economic life.

Moreover, the composition of the U.S. electric supply system is changing. In the 1980s, virtually all new generating capacity was baseload, and by 1990, the proportion of baseload capacity was above historical norms. As a result, much of the new capacity being built today is peaking capacity. By the year 2000, the proportion of peaking capacity will be at an all-time high, and the proportion of baseload will be near or below the historic norm. This suggests that the United States will need new baseload power plants in the next decade. The industry believes that new nuclear plants will be selected to help meet demand for additional baseload capacity for several reasons:

- Emission limitations and "air pollution caps," such as those required by the amendments to the Clean Air Act, will increase the cost and potentially limit the ability to generate electricity from fossil-fueled plants in certain areas.
- Increased emphasis by policymakers on actions to limit greenhouse gas emissions will result in a greater priority on generating plants that do not produce greenhouse gases. Some policymakers are calling for an "emission-free portfolio" for new power generation additions that would maintain the existing U.S. percentage of electricity that comes from emission-free sources, including nuclear and renewable energy.
- There will be increased uncertainty regarding the price and reliability of supply and delivery of large quantities of natural gas for use in baseload power plants, as well as increased recognition that renewable energy alone, despite its popularity, will not be able to fill the gap in electricity demand.

NUCLEAR PLANT GENERATING CAPACITY AND LICENSE EXPIRATIONS

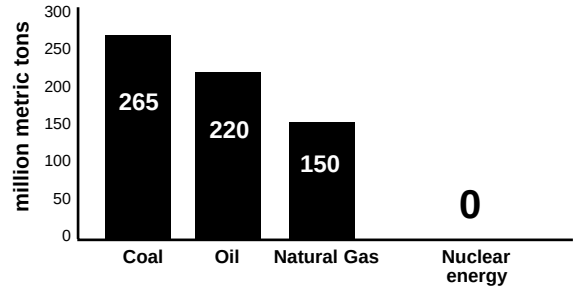


- Today's more than 100 U.S. nuclear plants have an outstanding and upwardly trending record of performance, and the industry has numerous initiatives under way to further improve their operations. Extensive operating experience with today's plants and the promise shown in the Advanced Light Water Reactor (ALWR) Program provide a strong foundation for continued, and expanded, reliance on light water reactor technology.

- Experience from the construction of ALWRs in other countries will provide the foundation to proceed with new nuclear plant orders in the United States.

- A 1992 study by the nation's most prestigious scientific organization, the National Academy of Sciences, "Nuclear Power: Technical and Institutional Options for the Future," commended the research and development (R&D) objectives of the ALWR Program. A study completed in 1997 by the President's Committee of Advisors on Science and Technology underscored the benefits of nuclear energy to the nation and recommended substantially increased federal funding for nuclear energy R&D.

METRIC TONS OF CARBON RELEASED TO PRODUCE ONE MILLION KILOWATT-HOURS OF ELECTRICITY



In the next few years, companies must start planning for new power plants to meet increased demand and to replace plants that reach the end of their operating lives. The intent of this plan has been to ensure that when new baseload generating plants are needed, the nuclear energy option will be available. The need for new baseload power plants early in the next century dovetails well with the significant progress made on all fronts under this strategic plan. The discussion below describes the many important elements of the nuclear option that have been put in place through the implementation of the strategic plan, as well as the significant challenges that remain.

ACCOMPLISHMENTS UNDER THE STRATEGIC PLAN

The strategic plan was comprehensive in that it encompassed both technical and practical prerequisites to building new nuclear plants, as well as the long-term institutional challenges facing the U.S. nuclear energy enterprise.

First and foremost, the industry is justifiably proud of the advanced standard designs that have been the principal technical focus and success of the strategic plan, including the 1,350-megawatt (MWe) General Electric Advanced Boiling Water Reactor (ABWR), and two advanced pressurized water reactors, the 1,350-MWe ABB Combustion Engineering System 80+ Standard Plant, and the 600-MWe Westinghouse AP600, which features innovative passive safety systems. These designs continue the tradition of U.S. leadership in nuclear technology by combining more than 40 years of industry experience in the design and operation of nuclear plants with the most exhaustive safety reviews ever performed by the U.S. Nuclear Regulatory Commission (NRC). Strong overseas interest—including purchases, commitments and other expressions of interest by a number of Asian nations—indicates that the superior safety, reliability and economics of these advanced designs is recognized worldwide and accepted as the basis for their continuing nuclear power plant programs. The many safety features of the ABWR, System 80+ and AP600 designs are described in Appendix C.

Important developments are occurring in Asia. General Electric's ABWR design has been built by the Tokyo Electric Power Company at its Kashiwazaki-Kariwa site, and both units of this twin-unit station are in operation. The Korea Electric Power Corporation's Yonggwang two-unit plant, which became operational in 1995,

incorporates many features of the ABB-CE System 80+ design; four other plants with additional System 80+ enhancements are under construction in Korea. The Taiwan Power Company has ordered a twin-unit ABWR from General Electric, and excavation of the Lungmen site as well as equipment fabrication and procurement are underway.

A number of other key prerequisites to building new nuclear plants have been achieved and are highlighted in this report, including:

- dramatic and continuing improvement in operating plant safety and economic performance.
- advanced, standard designs per utility specifications, certified by the NRC, and available for order.
- completion of cost-shared first-of-a-kind engineering programs with DOE, including cost and schedule estimates for ALWRs.
- development of standard organizational plans and operational processes for future plants.

In addition, important progress has been made on a number of long-standing institutional issues, including enhancing policymaker and public recognition of the need for nuclear energy; efficient management of low-level waste; passage of spent nuclear fuel legislation; assuring an adequate, economic fuel supply; and ensuring that policies of federal and state governments and the financial community recognize the total, long-term benefits of nuclear energy to the nation. However, efforts in these areas involve extremely long-term or ongoing initiatives, some of which were under way before this strategic plan was launched and will continue beyond it. As described in the individual building block final reports in Section III, these initiatives will continue in order to establish the conditions that will bring about new nuclear plant orders and position the nuclear industry for the 21st century.

Fourteen enabling conditions—the "building blocks" of the strategic plan—were identified for accomplishing the goals of the plan, and the following synopses highlight the progress achieved since 1990 in each building block.

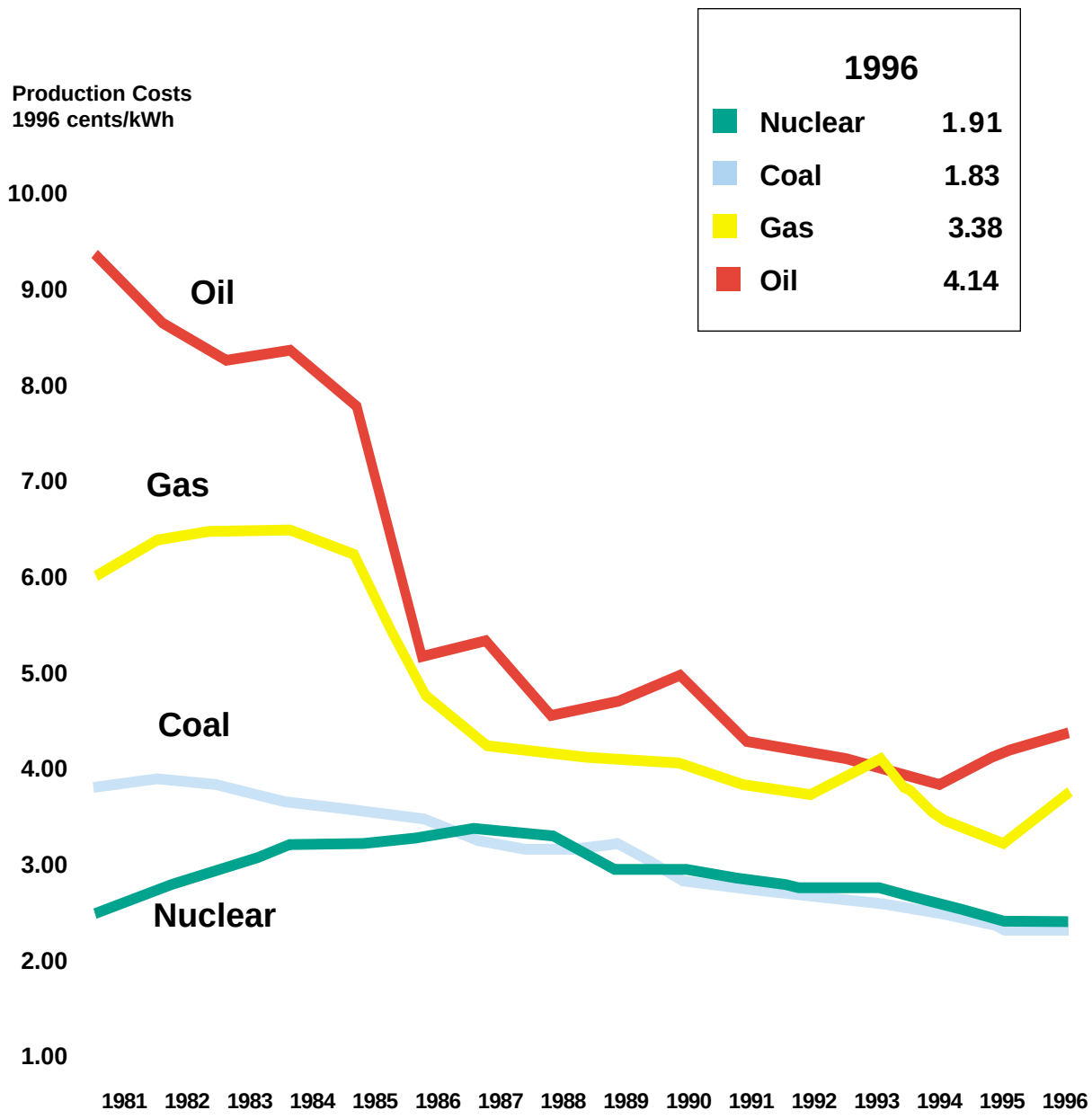
Building Block 1
Current Nuclear Plant Performance

U.S. nuclear plant safety and economic performance has improved dramatically in the 1990s. Median unit capability factor was 81.6 percent in 1997—a 14 percent improvement over 1990. The remarkable reduction in the median length of refueling outages—from 78 days in 1990 to 48 days in 1997—was a major contributor to the reduced production costs and increased productivity that have characterized recent industry performance. The industrywide average cost of producing electricity using nuclear energy in the United States (operation, maintenance and fuel costs) fell to 1.91 cents per kilowatt-hour in 1996, a significant improvement over the 1990 cost of 2.63 cents per kilowatt-hour. In fact, in 1996, two-thirds of the nation's plants produced electricity for less than 2 cents per kilowatt-hour. As impressive as these operational and economic results are, they were matched over this period by equally dramatic improvements in safety and reliability as measured by both industry and NRC performance indicators. The industry exceeded its year-2000 goal for safety system performance eight years early—in 1992. In 1997, 94 percent of safety systems were already achieving the year-2000 goal. Energized by the challenge of a restructured, competitive electricity marketplace, the industry is striving to continue its impressive record of safety and performance improvement.

Building Block 2
Predictable Licensing and Stable Regulation

The new licensing process established in 1989 by the NRC (10 CFR Part 52) has begun to deliver on its promises to encourage development of advanced standard nuclear plant designs and to provide a more predictable, stable process for licensing new nuclear plants. Ten years of determined effort by both the industry and the NRC culminated in May 1997 with one of the most significant regulatory actions in recent years: issuance of the first-ever design certification rules. The certifications, for the General Electric Advanced Boiling Water Reactor and the ABB Combustion Engineering System 80+ Standard Plant, signified completion of the crucial first step in the Part 52 process, reaffirmed key principles of the new licensing process, and provided a

U.S. ELECTRICITY PRODUCTION COSTS



solid foundation for future plant orders in the United States. A third ALWR, the Westinghouse AP600, is also moving nearer to design certification.

Building Block 3
ALWR Utility Requirements

Building Block 3 has focused on developing a comprehensive set of utility-prescribed design requirements for both evolutionary and passive ALWRs, obtaining NRC approval, and assuring that the ALWR designs conform to these requirements. The development of the ALWR Utility Requirements Document (URD) was initiated in 1985, and the first complete version was published in 1990. The document has been revised several times to reflect continuing feedback from the design certification projects and interactions with the NRC. The NRC approved the evolutionary and passive plant URDs in 1992 and 1994, respectively, through issuance of final safety evaluation reports.

As the detailed development of the three advanced designs has progressed, conformance assessments have been made as part of their respective design certification and first-of-a-kind engineering activities to assure that the designs comply with the URD specifications. These assessments have revealed a very high level of URD conformance, thus providing a degree of assurance that the designs were licensable and that future plants will achieve stated ALWR performance goals for safety, reliability and economics. A final version of the URD is planned for June 1999. This version will incorporate the results of the final design certifications and first-of-a-kind engineering.

Building Block 4
NRC Design Certification

Certification of standard nuclear power plant designs under 10 CFR Part 52—the reformed nuclear plant licensing process of the NRC—is an important U.S. initiative aimed at overcoming institutional uncertainties in the design approval and licensing process for future plants. Pre-approval of advanced nuclear plant designs through NRC design certification is also expected to significantly reduce the time and cost required to license and construct nuclear power plants—major factors in determining whether new nuclear plants will be built. With these aims, the U.S. ALWR Program was launched jointly by industry and government in 1986 to revitalize the nuclear option. The plant designers undertook the responsibility of applying for NRC certification of their advanced designs and implementing utility-specified design and performance requirements.

Capping the most exhaustive safety reviews ever performed for new nuclear plant designs, the NRC issued its first-ever design certifications in May 1997 for the 1,350-megawatt General Electric Advanced Boiling Water Reactor and the ABB Combustion Engineering System 80+ Standard Plant designs. NRC final design approval, a key prerequisite for design certification, is expected in 1998 for a third design, the 600-megawatt Westinghouse AP600. Certification of a fourth ALWR design, the 600-megawatt GE Simplified Boiling Water Reactor, has been deferred. It was part of the initial ALWR program funded by industry and DOE, but was redirected in early 1996 due to lack of funding to complete certification. In 1996 and 1997, testing and analyses were completed that would facilitate resumption of SBWR development at a future date.

Building Block 5
Siting

Site approval is another key step in licensing of new nuclear plants. Under the NRC regulation, 10 CFR Part 52, plant siting can occur under early site permit (ESP) activities or as an element of combined construction and operating license (COL) activities. Because anticipated interest in prospective sites for new plants did not materialize, industry efforts focused on evaluating the readiness of existing regulations, standards and guidance to accommodate future siting applications.

Joint DOE-industry activities concentrated on the development and demonstration of site selection criteria and analysis tools. In addition, EPRI and NEI sought to identify any impediments or conflicts in the implementation of Part 52 by conducting substantive technical and licensing reviews for the ESP and COL siting

processes. They concluded that the technical tools and regulatory process are in place to effectively evaluate and gain NRC approval of new nuclear plant sites. Specifically, they determined that 1) there are no significant regulatory impediments to either siting process and, in general, the siting aspects of Part 52 are supported by existing regulatory requirements, and 2) the necessary technical products to characterize, qualify and license an ALWR site are available.

Building Block 6
First-of-a-Kind Engineering

Building Block 6 has focused on completing the first-of-a-kind engineering (FOAKE) programs for the ABWR and the AP600. The products from the FOAKE activities take the level of plant design completion from that required for design certification to a more detailed level that supports commercial standardization and includes definition of full-scope cost and schedule estimates. The ABWR FOAKE deliverables were completed in September 1996. The key AP600 FOAKE deliverables have been completed, and AP600 FOAKE will be officially completed in 1998 after the NRC issues its final design approval on the AP600 design.

As an element of the FOAKE process, standardization plans were developed in mid-1994 and implemented during the development of the detailed designs. These plans describe the designer's management approach for design standardization and provide additional assurance that the detailed designs meet the intent of the industry *Position Paper On Standardization* (Appendix D). In addition, a "Framework for a Generic ALWR Standardization Agreement" was produced in April 1994. This framework is a roadmap for families of future ALWRs to maximize and sustain the benefits of standardization over the life of the plants.

Building Block 7
Life-Cycle Standardization

Originally entitled "Enhanced Standardization Beyond Design," this building block is based on Section 5 of the *Position Paper on Standard-ization* (Appendix D) and addresses standardized functions and processes for operation of a family of plants and resolution of related issues that impact them. The title of this building block was changed in 1992 to "Life-Cycle Standardization."

Domestic and international operational and standardization experience was used by industry development and review teams to establish principles, objectives and work processes for standard nuclear plants. As the potential to also improve the effectiveness of operating plant processes became evident, participation grew to include the major suppliers and utilities representing over 80 percent of existing U.S. plants. Seven major plant process groups were identified, and 15 associated process descriptions have been issued for industry use and comment. Today, several utilities are implementing these process descriptions to effect improvements in their work processes. The lessons learned from utility experience will be incorporated into future revisions of the process descriptions so that a validated set of standardized work processes will be available for ALWR plants.

Building Block 8
Enhanced Public Awareness

Surveys taken in 1990 and again in 1998 show that a strong majority of Americans continues to believe that nuclear energy is an important energy source for the future. In a January 1998 survey of college graduates who are registered voters, nearly two-thirds said they personally favor the use of nuclear energy. But they erroneously perceived that others are more likely to be opposed. Closing this "perception gap" is a major focus of the industry. The industry—through NEI—redirected its efforts to enhance support for nuclear energy from a broad, public audience to a more targeted policymaker and opinion leader audience, as represented by the group surveyed in early 1998. The change in strategy was a direct response to changes in the administration and in Congress, the ongoing transition to a competitive U.S. electricity marketplace, and growing worldwide concern about clean air and global climate change. In communicating about these challenges and the need to ensure nuclear energy's viability in the 21st century, nuclear energy's undeniable environmen-

tal benefits and impressive record of improved safety and performance remain key themes.

Building Block 9
Clarification of Ownership and Financing

There have been major changes in the electric power industry since the strategic plan was first conceived in 1990. The most significant changes—industry restructuring and the emergence of competition—are still in progress.

As a result, there will be changes in ownership structure and financing of future electric generation capacity, including nuclear power plants. The industry's continuing focus is on ensuring recognition of the proper value of current and future nuclear plants—not just in terms of pure economics—but also in terms of their contribution to national environmental and energy policy goals.

Building Block 10
State Economic Regulatory Issues

A number of states are considering various forms of deregulation and/or industry restructuring. Others are taking a more wait-and-see attitude. More than a dozen states have acted—either through legislation or regulation or both—to restructure their electric power industries, generally providing a transition period before retail competition takes full effect, and allowing companies a reasonable opportunity to recover their stranded costs through some form of competitive transition charge. In addition, Congress is considering legislation to restructure the electric utility industry. Ongoing industry efforts in this area are focused on advocating fair treatment of existing and new nuclear investments, recovery of decommissioning obligations from customers, and state regulatory practices that allow nuclear plants to compete fairly with alternative generating options.

Building Block 11
High-Level Radioactive Waste

Building Block 11 is aimed at encouraging federal progress in managing spent nuclear fuel. The key feature of the program should have been Energy Department acceptance of spent fuel beginning January 31, 1998. This did not happen and, without additional reform of the federal program, will not happen until 2010 at the earliest, when DOE currently plans to begin repository operations. Electric utilities are having to rely increasingly on dry fuel storage when running out of on-site pool storage space. The delay until 2010 will cost electricity consumers about $7 billion in additional storage costs. A major legal proceeding is ongoing between the utilities/states and DOE to enforce the department's obligation, to determine how the situation will be remedied, and to recover damages. So far, nuclear utilities and their customers have committed over $14 billion to the federal spent nuclear fuel program.

DOE has made significant progress at Yucca Mountain, the potential repository site. A working program plan lays out top-level milestones. Management has been revised and improved, budgets have been reduced, and greater insight into the licensing challenges has been gained. DOE took the innovative approach of developing a viability assessment of Yucca Mountain, which will provide insight into the potential repository several years before submittal of a license application to the NRC. Some small progress has been made on interim storage and transportation in that generic planning and licensing documents have been developed, and DOE has developed plans for greater private-sector involvement in transportation.

However, new legislation designating a centralized interim storage site is required to ensure that DOE fulfills its obligation to accept spent fuel. During 1997, bills consistent with the nuclear industry's policy passed both houses of Congress by substantial bipartisan margins and are awaiting further action in 1998.

Building Block 12
Low-Level Radioactive Waste

The nuclear energy industry has more than met the challenge to support the development of new low-level waste disposal capacity. The industry has spent over $600 million supporting development of new disposal capacity under

the Low-Level Radioactive Waste Policy Act of 1980, as amended in 1985. In addition, significant political capital has been spent in supporting the passage of state and federal compact legislation. Although no new sites have been opened under this process, new facilities in California and Texas could be available in the near term.

The industry also has achieved remarkable results in the waste minimization and volume reduction areas. Waste volumes have been reduced by 94 percent since 1980. The focus of continuing industry efforts is on maintaining access to existing disposal capacity, supporting development of viable new capacity, and fostering competition for waste management services.

Building Block 13
Adequate, Economic Fuel Supply

A number of developments since 1990 have had a profound impact on the world market for nuclear fuel and fuel services. These include progress toward U.S. Enrichment Corporation privatization, limits on import of uranium from states of the former Soviet Union, availability of surplus uranium and plutonium from the weapons programs of the United States and Russian Federation, and controversies surrounding utility liability for the cost of decontamination and decommissioning of U.S. uranium enrichment facilities. Industry efforts in these areas are ongoing. Throughout this dynamic period, the industry has maintained its focus on assuring a continuing stable and economic supply of nuclear fuel for current and future plants.

Building Block 14
Enhanced Governmental Support

Growing federal recognition of the importance of retaining and, in fact, expanding the nuclear energy industry is the result of far-reaching U.S. industry and government policy initiatives during the past eight years both domestically and internationally. In the United States, the transition to a competitive electricity market has forced policymakers on the state and federal levels to re-examine nuclear energy—not solely in the context of electricity supply, but as an energy source that will play a vital role in the nation's economic growth and in meeting current and emerging clean air standards. Growing federal recognition of the importance of nuclear energy is especially evident in:

- actions related to restructuring of the electric-generating industry.
- reliance on nuclear energy to meet clean air regulations and avoid greenhouse gas emissions and other air pollutants.
- approval of nuclear technology exports to China.
- congressional action on nuclear waste management.
- policies related to disposition of nuclear weapons materials.
- recognition of the need for increased nuclear energy research and development.

The impact of these matters on broader issues playing out on the international stage, such as energy security, worldwide nuclear commerce, and protection of the global environment, have also contributed to recognition among U.S policymakers of the long-term need for nuclear energy.

BEYOND THIS STRATEGIC PLAN

While this report brings to a close the activities under this strategic plan, the industry remains committed to its original goal: to establish the necessary conditions for bringing about new nuclear plant orders in the United States. Conditions that are not yet fully in place, including institutional policies and practices conducive to nuclear energy, will be pursued as part of a more comprehensive industry strategy for positioning nuclear energy for the 21st century. Among the activities that will continue to be vigorously pursued are:

- complete the AP600 final design approval, design certification and first-of-a-kind engineering.
- continue to improve plant operating and safety performance and continue to demonstrate that economic and safety improvements go hand in hand.

- continue to build support for nuclear energy and recognition of its benefits among political leaders and the general public as the major source of safe, reliable, emission-free electricity for meeting U.S. needs in the 21st century.

- continue to support license renewal for existing nuclear plants.

- ensure that state and federal policies shaping a restructured, competitive electricity marketplace reflect the importance of nuclear energy to the long-term national interest.

- stay the course on pressing for the necessary federal, state and local action to address spent fuel disposition and low-level waste management.

- continue to work with the NRC and Congress to ensure regulatory policies and practices do not unduly put nuclear plants at a competitive disadvantage relative to alternative baseload generating technologies.

- continue to work with the NRC staff to establish appropriate emergency planning requirements for ALWRs and to develop common understandings of the Part 52 licensing process, including key issues related to licensing, construction verification and transition to start-up.

- continue emphasis on applying "spin-off" benefits of the Utility Requirements Document and the new ALWR designs to improve the safety, reliability and economics of existing plants.

- identify opportunities to further demonstrate the early site approval process.

- prepare to assist prospective owners/operators of future plants in the further development and regulatory acceptance of standardized operating processes and in the preparation and NRC review of license applications.

- continue efforts to assure an adequate, economic fuel supply to meet the needs of current and future nuclear plants in the United States.

- monitor and learn from ALWR construction and operating experience overseas to enhance planning for new plant orders in the United States.

Just as industry-government cooperation in research and development has been a key subplot to the progress made toward the goals of this strategic plan, expanding the scope and benefits of nuclear energy in the U.S. for the next century will require continued federal support. Most of the ALWR project-specific accomplishments under this plan could not have been achieved without a strong partnership between industry and the Department of Energy, with the strong support of Congress. While the industry funded about two-thirds of the total cost of this work, these resources would not have been made available without the cost-sharing and committed support of the federal government. The federally co-funded ALWR program was completed in 1997. Although no FY98 funding was provided for nuclear energy, key congressional leaders urged DOE to propose a new nuclear energy research and development program for FY99.

Recognizing the strategic importance of nuclear energy to the nation, and the essential role of R&D to support continued advances in nuclear technology, DOE and industry worked together in late 1997 to produce the *Joint DOE-EPRI Strategic Research and Development Plan to Optimize U.S. Nuclear Power Plants*. This plan is based on common goals and objectives for nuclear energy R&D that have already been endorsed by industry and government. It expands those goals and objectives into R&D tasks to meet these needs. The focus of the EPRI-DOE plan is on currently operating nuclear plants in the U.S.—exploiting new technologies to further improve their economic and safety performance, and to extend their safe and economically useful life beyond current licensed operation. The plan should also assist the license renewal process by ensuring the latest data are available to answer any technical questions that might arise during NRC review.

The EPRI-DOE plan also lists future R&D goals and objectives related to further improving efficiency and reducing costs associated with ALWR designs. These goals and objectives focus primarily on improved construction technologies, application of the latest digital technologies, and similar enhancements. These activities are not currently receiving either industry or DOE fund-

ing but are expected to be the focus of future resources.

It is important, between now and the onset of new orders, to continue these public-private partnerships in research and technology development in order to maintain nuclear energy as an economic, world-class, state-of-the-art option for powering our nation and the world.