THE U.S. NUCLEAR INDUSTRY'S CURRENT STATUS AND PROSPECTS UNDER ELECTRICITY DEREGULATION[1]

Neil J. Numark, President
Numark Associates, Inc.
Washington, D.C.

Presentation to the 34th JAIF Annual Conference
Session on "Nuclear Power Reevaluated in the Deregulated Electricity Market"
Aomori City, Japan
April 27, 2001

INTRODUCTION

Nuclear power was not supposed to be competitive under deregulation. Predictions from the early- to mid-90s were that many nuclear plants in the United States would have to shut down long before their licenses had expired due to their high costs, even though much of this cost stemmed from interest payments on sunk investment rather than going-forward operating costs.

But very few plants have in fact shut down early. Many of the plants that were in jeopardy have now been sold to larger companies better able to improve them. And most U.S. plants will renew their licenses to extend operation for another 20 years. As a result, the nation's nuclear plants are receiving sustained praise, for their strong performance and their stable, competitive operating costs. They have also benefited from unprecedented media recognition of their importance, in an era of disappearing reserve margins and even rolling brownouts. U.S. newspapers have featured articles in the last few months with headlines like "Nuclear Power May Rise Again,"[2] "Nuclear Energy Showing Rebirth,"[3] and just this week in the *Washington Post*, "Nuclear Power May Be Making A Comeback."[4]

A quick review of the performance data shows why, beginning with production costs.[5] As Figure 1 illustrates, nuclear production costs have been consistently low in relation to fossil fuel

---

1 Based in part on: Robert D. MacDougall and Neil J. Numark, Numark Associates, Inc., "Conquering Deregulation: How the U.S. Nuclear Industry is Doing It," *Gensan* (journal of the Japan Atomic Industrial Forum), No. 57, October 2000, pp. 13-29.

2 T. McDermott, "Nuclear Power May Rise Again," *The Los Angeles Times*, February 9, 2001.

3 Nuclear Energy Showing Rebirth," *The Arizona Republic*, February 10, 2001.

4 P. Behr, "Nuclear Power May Be Making A Comeback; Energy Crunch Helps Ease Industry's Image as Outcast," *The Washington Post*, April 23, 2001, p. A1.

5 Figures from Nuclear Energy Institute, "Nuclear Energy: Increasing Value in a Competitive Market," Annual Briefing for the Financial Community, February 2, 2001.

production costs over the last 20 years and are today less than 2 cents per kWh. Of course, more kWh produced is a big part of this story, and Figure 2 shows the growth in the nuclear industry's total electricity output through the 1990s. This in turn is largely due to the trend shown in Figure 3 of substantially improved plant capacity factors.

What explains these unexpected good results? One part of the answer is certainly the lessons learned from years of operating experience. But deregulation itself appears to be an important part of the story. Contrary to early expectations, deregulation has not stifled nuclear power in the United States but rather appears to be stimulating its competitiveness. Regulated utilities of the past were guaranteed a fixed rate of return on their investments, in exchange for providing reliable supply at stable, regulated prices. Operators did not have to worry as much about expenditures as today, when they have more incentive to be cost-competitive. Even in the states that have not yet instituted retail competition, nuclear operators have reduced costs and raised output, probably just as well as in other states, perhaps in anticipation of the deregulation that will eventually affect everyone.

Furthermore, deregulation has caused a very beneficial restructuring of the industry. With the forced “unbundling” of generation companies from transmission and distribution companies, nuclear plant operators have consolidated a great deal, through four mechanisms:

- the sale of nuclear plants from one company to another;
- the merger of generating companies;
- the formation of joint operating companies; and
- the transfer of assets between utilities.

The result is presented in Figure 4, which shows the emergence of a much smaller number of nuclear plant operators in the United States than ever before. And this number is sure to continue going down, through plant sales and other mechanisms. The five largest operators already account for almost half of the nation’s nuclear plants. For the stronger operators who have a corporate commitment to nuclear energy, nuclear plants are much more valuable than they were to the sellers who had difficulties operating them successfully or at least had a small number of units and could not benefit from economies of scale.

As a result of this transition from vertical to horizontal integration of the electric power industry, on the whole the operators of U.S. nuclear plants are companies that want to be in the nuclear generating business much more so than a few short years ago. Thus, it is increasingly only the stronger companies that remain in the game, but almost all of the plants remain (and there is talk of re-starting certain plants that have shut down). Furthermore, there are now improved economies of scale, which has benefits in outage management and in procurement buying power. Finally, this restructuring is a very large part of the explanation for the high rate of license renewal applications. Even companies that may be selling reactors are going through renewal, which increases the value of their plants.

It is important to note that most of this consolidation has only taken effect in the last three years or so, and does not explain the performance improvements that occurred in the early 1990s. But it does explain why certain plants that were previously in jeopardy of shutdown are now staying alive and being invested in for the future.

Certainly another important factor underlying nuclear energy's much-improved standing is that state regulators have permitted utilities to recover stranded costs -- mainly unpaid debts -- more

so than originally expected, through higher regulated rates during longer transitions to open markets. These are costs that were approved by state regulators in the regulated era, but that would not likely be recoverable from power generation revenues at expected prices in competitive markets.

So there have been important regulatory and structural changes benefiting nuclear power in the United States. But, largely in response to the onset of competition, U.S. nuclear plants have simply become more productive, cheaper to operate and maintain, and at the same time – by NRC measures -- safer than they were even five years ago, at the threshold of the retail competition era. I will explore in a few minutes what specific steps the U.S. nuclear plant operators have taken to achieve these results

Outlook for Deregulation

And despite the California energy crisis, the outlook for continuing deregulation of electricity markets is good. Major industrial customers continue to press for cheaper power, and as a result, individual states will continue to deregulate so as to attract and retain these industries. The pace of deregulation has recently slowed in response to the California crisis; of the 24 states and the District of Columbia that have already mandated deregulation (see Figure 5), three small states have now taken steps to slow down its implementation. For the remaining 26 states that have not yet instituted retail competition, it is difficult to assess what influence the California situation is having on what they have yet to do. It should be noted that the states in the southeast already have relatively inexpensive power and have been moving more slowly into retail competition.

On the road to complete deregulation, the largest transition pain, of course, is reliability. Regulatory uncertainty has had a chilling effect on investment in new generating as well as transmission capacity since the early 1990s. The transmission system has become increasingly antiquated and reserve margins have declined severely in some areas, as the economy has rapidly grown and conservation measures have been de-emphasized, with little regulatory oversight to ensure reliability. We can only hope that as regulatory certainty increases, competition will give companies the confidence to make the necessary investments.

It is important to note that the timing of deregulation in the United States may explain these transition pains to a large degree. Deregulation began when there had already been little new construction for a decade or so, and we have just been through a major spurt in economic growth that has increased demand, including a 10% increase in demand from 1995 to 1999. In other words, deregulation would obviously be easier if we had had more generating and transmission capacity coming into the process.

How the Plants Have Become More Competitive

The charts I showed earlier illustrate the results, and I would like to look deeper for some of the explanations of the improved performance. This discussion is not comprehensive but rather exemplary, as we have not performed a complete analysis of the reasons.

One key factor in the increased output of U.S. nuclear plants has been the ability to increase the rated thermal power levels at many plants. Figure 6 summarizes past and pending uprates approved by the U.S. Nuclear Regulatory Commission. Forty-seven units – almost half of the U.S. fleet – have been or will be approved for uprates of 5-10% of their originally-licensed limits,

and four units have already been approved for uprates exceeding 10% of original limits. For example, in 1999 NRC approved a new rule allowing companies to reduce the power held in reserve for Emergency Core Cooling System performance, with the difference thus being available as output. This can be used by all 103 units for a 1% uprate. As the NRC announced, the rule "allows interested licensees to pursue small, but cost-beneficial power uprates and reduce regulatory burden without compromising the safety margin of a facility."[6]

Further power uprates are likely throughout the industry, driven by competition. As a recent example, the Tennessee Valley Authority is now considering uprating its two Browns Ferry units by a total of 250 MW at a cost of $99 million, which the company says would not require NRC approval.[7] It is difficult to assess how much further uprating can be expected. An NRC official commented recently that when U.S. plants were first licensed to operate, "we were pretty conservative. We didn`t have the operating experience and analytical capabilities we have now, and plants were licensed at lower power levels than they needed to be."[8]

A second key factor has been the shortening of outages for refueling and maintenance. As Figure 7 illustrates, average outage durations have fallen dramatically, from over 100 days in 1990 to only 40 days last year. Those 60 additional days online account for more than a 15% improvement in plant output. Also, far fewer companies are shutting down for planned maintenance between refuelings. One factor that helps explain shrinking outage length is the increasing trend among operators of sharing good outage management practices and lessons learned, which was well documented in a *Nuclear News* article last year.[9] Some managers credited the restructuring of the electric power industry for the increasing industry recognition that, although some nuclear plants are competing with each other, the industry as a whole also has to compete with fossil fuel-fired power plants. Predictions are that average refueling shutdowns will decrease to just 20 or 30 days in the coming years.

Third, besides shortening outages, nuclear plant operators have also managed to perform them less frequently. Extended burnup fuels are allowing 18- and even 24-month fuel cycles. The limit on this trend may be economic rather than technical, as it is of course far preferable to time outages during periods of relatively low demand. Also, with consolidation, larger fleets of reactors are forming, as discussed earlier. With this, the number of trained outage personnel in these larger companies may impose constraints on the timing of outages.

Finally, the NRC`s commitment to implementing "risk-informed regulation" has been an important development that appears to be allowing enhanced competitiveness of U.S. plants. Risk-informed regulation is a relatively new buzzword, but the debate over probabilistic vs. deterministic regulation has been going on at least since the 1979 Three Mile Island accident. The traditional deterministic approach assumes that any safety problem that has the potential to occur will in fact occur. Risk-informed regulation considers information about the probability and consequences of a potential safety problem, and – according to NRC – "focus[es] licensee and regulatory attention on design and operational issues commensurate with their importance to

---

6 U.S. Nuclear Regulatory Commission, *Weekly Information Report – Week Ending January 29, 1999*, http://www.nrc.gov/nrc.commission/secys/1999-037scy.html (February 4, 1999).

7 T. Harrison, "TVA Board Considers Uprates for Brown's Ferry, Sequoyah," *Nucleonics Week*, April 19, 2001, p. 3.

8 U.S. Nuclear Regulatory Commission official, private interview with Numark Associates, July 11, 2000.

9 R. Michal, "Outage Personnel Describe Concerns and Trends," *Nuclear News*, June 2000.

health and safety."[10] NRC states further that "[probabilistic risk assessment] and associated analyses… should be used in regulatory matters, where practical within the bounds of the state-of-the-art, to reduce unnecessary conservatism associated with current regulatory requirements, regulatory guides, license commitments, and staff practices."[11]

Risk-informed regulation is surely a good way to devote more attention to the higher-priority safety concerns and expend less resources on items of lower safety significance. NRC has changed the way it regulates but has not eased it. They have adopted ways to get the "most bang for the buck" that are helpful in a deregulated environment. By addressing the problems first whose likelihood of occurring is supported by data and analysis (or operational history), rather than applying the deterministic approach that looks at all systems as having an equal chance of failure, the industry should be able to mitigate safety problems more effectively while also improving safety.

The recent NRC rule change allowing companies to reduce the power held in reserve for Emergency Core Cooling System performance, described earlier, is an example where risk-informed regulation has already been applied. Another has been relief from costly NRC requirements for in-service inspection and testing that have marginal payoffs in risk reduction. Other potential future applications include plant maintenance; inspection and enforcement programs; fire protection; incorporation of risk insights into the review of advanced reactor designs; changes to specific technical requirements in NRC standards based on risk information; and improvements to technical specifications.

With all of these steps to improve the performance and competitiveness of U.S. nuclear plants in response to deregulation, the NRC considers safety to be higher, and notes that "all the evidence suggests that the safety and reliability of the nuclear industry has improved markedly since the late 1980s and early 1990s."[12] NRC performance indicators shown in Figure 8 illustrate safety improvements according to several different measures. Thus, it appears that safety and performance improvements are proceeding hand in hand, perhaps reflecting a recognition by operators that safety problems will lead to costly plant shutdowns and need to be avoided.

It is important to underline that the NRC itself, of course, is not deregulating. While the above-mentioned measures to improve plant performance have required the approval of the NRC, the agency has certainly retained the same overall safety requirements and enforcement policy. NRC's flexibility in certain areas reflects the agency's willingness to "reduce unnecessary conservatism" when improved data and analyses demonstrate that prior requirements were indeed unnecessarily conservative.

NRC has also expressed certain concerns about deregulation and its impact on safety. One relates to the reliability of the electric grid in the event of a station blackout incident. Others are the financial health of nuclear plant operators, and the adequacy of funds for decommissioning. Beyond these, watchdog groups have also expressed concern about the corporate resources available for off-site responses in the event of a plant emergency.

---

10 U.S. Nuclear Regulatory Commission, *White Paper on Risk-Informed, Performance-Based Regulation*, http://www.nrc.gov/nrc/commission/vote/1998-144vtr.html (February 24, 1999).

11 U.S. Nuclear Regulatory Commission, *Risk-Informed Regulation Implementation Plan*, October 2000.

12 U.S. Nuclear Regulatory Commission, *Primer on Reactor Oversight Process*, http://www.nrc.gov/opa/primer.htm.

It is interesting to look at the comments of one of the NRC's most influential watchdogs, the Union of Concerned Scientists, concerning the safety of plants that have increased performance and output. According to David Lochbaum of UCS:

> There's been a greater focus on plant output, but that doesn't necessarily mean exactly the opposite of safety. You can do both. For example, power uprate takes up some of the margin that's built into the plant, but if that's done prudently and wisely and with forethought then that's acceptable. We don't have an issue with that.[13]

Lochbaum also notes that the trend of improved performance reflects the fact that for several years after the 1979 Three Mile Island accident, the industry had to perform extended outages to implement backfits, and that subsequently a number of plants have had to perform long outages for steam generator repair and replacement. When those were finished, says Lochbaum, outages could begin to come down and be dictated mainly by refueling.

License Renewal

U.S. nuclear plants are licensed for initial terms of 40 years. Most plant operators are now concluding that it is far cheaper to extend the operation of these amortized units than to replace them with new generating facilities. Some estimate the cost as low as $10 to $15 million. As illustrated in Figure 9, NRC has already approved 20-year license extensions for five units; is currently reviewing applications for a further five; and has released firm dates over the next three years when it anticipates receiving applications for another 28 units. The agency also reports that it has received confidential tentative dates for 16 more units as well as expressions of interest for yet another 43.

New Reactors

The question concerning new nuclear plant orders in the United States has evolved in the past year or two from "whether" to "when" and "what kind." The short answers to these questions appear to be "soon" and "different kinds."

Furthermore, the question of "who" has become clearer, with companies such as Entergy and Exelon likely to be among the earliest players. Entergy commented at a recent Congressional hearing that when capital costs can be reliably predicted to be $1000/kW or less, a new plant will be built in the United States. Entergy noted that "industry executives have come together to develop a plan that will mark out a clear path for new nuclear plant orders."[14]

---

[13] Numark Associates Interview with David Lochbaum, Union of Concerned Scientists, on Nuclear Energy and Safety Policy, January 2000, http://www.numarkassoc.com/policy/lochbaum.htm.

[14] C. Randy Hutchinson, Senior Vice President, Business Development, Entergy Nuclear, Inc., Testimony before the U.S. House of Representatives, Subcommittee on Energy and Air Quality, Hearing on National Energy Policy: Nuclear Energy, March 27, 2001.

Entergy and Exelon appear to be taking different approaches with respect to reactor type, however. While Entergy (and other companies) focus on standardized advanced light water reactors (ALWRs) offering safety and economic improvements over existing plants, Exelon chairman Corbin McNeill has been particularly vocal in his view that large scale plants will not have a place in the competitive U.S. market.[15] Exelon has now joined the international consortium developing the 120 MW-scale Pebble Bed Modular Reactor (PBMR) design of the South African utility Eskom, which they expect will provide much greater inherent safety than existing plants. A demonstration unit could begin construction in South Africa later this year. Exelon stated at the recent Congressional hearing:

> To be able to compete in the deregulated wholesale power markets, which have distinctly unique regional characteristics… new plants must be able to be permitted and brought on-line quickly, in thirty-six to forty-eight months at the most, and they must be able to compete with gas-fired combined cycle power plants on a total cost basis in the 3 to 3.5 cents per kilowatt-hour range. They must be small enough so that as their capacity is added to the market, an oversupply situation is not created in the region that drives prices down below the producers' marginal costs. They must also meet the environmental constraints of the region. We don't believe that the currently available designs of light water reactor nuclear power plants can meet all of these criteria. We believe that the PBMR is the only reactor currently under development that may be able to meet the needs of this deregulated marketplace in the next five years. We intend to find out if it can.
>
> If Exelon's review of the feasibility study is favorable, we do not intend to wait for the completion of the demonstration plant in South Africa to begin the licensing process to build *a number of PBMR's in this country* [emphasis added]. We would intend to submit a license application for early site permitting in 2002, followed by an application for a combined construction and operating license in 2003 after the detailed design is completed in South Africa. We believe that the licensing process, under the best of circumstances, could be completed in twenty-six months; but in reality, the time required is unknown.[16]

Apart from Exelon, there does not appear to be wider industry interest in the PBMR. Executives at other major generating companies with whom we have spoken continue to favor larger units that take advantage of economies of scale, such as the Westinghouse AP-1000, a potential successor to the smaller AP-600 advanced LWR which the NRC has already certified.

Thus, the views expressed to date by U.S. nuclear operators seem to suggest that large units as well as small modular ones are likely to be in our future. Exelon holds firmly to a "small is beautiful" worldview, based on the deregulated market conditions it expects in its service areas, while other companies remain just as firmly committed to the need for economies of scale. NEI

---

15 Corbin McNeill, Jr., Chairman, President & CEO, PECO Energy (now Exelon), testimony before the U.S. House of Representatives, Subcommittee on Energy and Power, Hearing on National Energy Policy: The Future of Nuclear and Coal Power in the United States, June 8, 2000.

16 Edward F. Sproat III, Vice President of International Programs, Exelon Corporation, Testimony before the U.S. House of Representatives, Subcommittee on Energy and Air Quality, Hearing on National Energy Policy: Nuclear Energy, March 27, 2001.

indicates that industry will begin NRC review of the AP-1000 and also implement a strategy to deploy the PBMR.[17] If the economics of these designs prove favorable and both classes of reactors can be developed for different market conditions, it could lead to a very important new wave of U.S. plant orders. It may be that vendors should join in the investment in lead plant construction, perhaps by committing to build them for $1,000/kW.

There are of course other vendor offerings under development, and this discussion is by no means meant to be complete but rather to identify what appear to be the primary near-term prospects. It is important to note the U.S. Department of Energy's program to develop "Generation IV" nuclear power technologies intended for 20 years or more from now. These designs are intended to be innovative technologies that would be safer, cheaper, less waste-producing and more proliferation-resistant than existing "Generation II" light water reactors and "Generation III" advanced light water reactors. Details concerning the Generation IV program are beyond the scope of this presentation. (Note that the reactors being discussed for the most near-term potential deployment, e.g. the AP-1000 and the PBMR discussed above, could best be described as somewhere between Generation III and Generation IV.)

Concerning siting, Entergy has indicated that it expects "several nuclear operators *to announce early site locations later this year* to begin the process to keep the nuclear option open in this country"[18] [emphasis added]. This action would take advantage of new NRC rules in which, if a certified design is used and the agency pre-approves the prospective site, it could issue a single license to construct and operate a new plant. I think it is a good bet that the first orders will be at existing nuclear sites which have room for more units, such as the numerous U.S. sites where several units were originally planned and only a portion of them actually built. In any case, it will surely be headline news if U.S. operators do indeed announce prospective sites this year, signaling a U.S. nuclear renaissance after more than a 20-year drought in new plant orders, even if actual orders remain a few years off.

One final word about deregulation vis-à-vis new reactors: the restructuring of the industry is probably speeding up the interest, by creating larger and stronger nuclear operating companies. Of course, climate change is probably having an impact as well. But the key determinant of the timing of new orders is still how far capital costs can be reduced, and how soon.

Political Context

I would like to close with a few general comments concerning the current status of energy politics in the United States. We are presently going through a period of major change in U.S. policy as a result of the transition to what is proving to be a very conservative Bush Administration. So far the change seems to send mixed signals to the nuclear industry. While Vice President Cheney has spoken out in favor of building more nuclear plants in the United States, the Administration is proposing substantial budget cuts including cuts to important nuclear R&D programs such as the Nuclear Energy Research Initiative and the Generation IV program that were initiated by the Clinton Administration. At the same time, the Administration's backing away from the Kyoto Protocol is very disappointing. On both the budget cuts and on climate change policy, there are

[17] See Note 5 above.
[18] See Note 14 above.

clear splits among top officials within the Administration; however, thus far the more conservative view is winning out on both counts.

This is certainly true on climate change. An important point in understanding the U.S. opposition to Kyoto is that we have had a "hangup" over the exclusion of developing countries. I think our preoccupation with this has resulted from a very successful public relations campaign by the fossil fuel industry-backed Global Climate Coalition, that was waged immediately after the Kyoto COP-3 meeting and convinced Americans that the Protocol was unfair because it excludes developing countries. The fact is, developing countries are only excluded in the first phase of the program, from 2008-2012, which seems wholly appropriate. In contrast with the fossil fuel industry's perspective, some US-based multinationals worry that the US will actually lose out if we delay action. A DuPont representative, for example, recently suggested that "it would be a mistake if the US economy is insulated from those pressures. When the reality comes, the US will have a bigger game of catch-up – and our competitors will be ahead of us."[19]

Note that if we continue on our present course, estimates are that U.S. carbon emissions will be *26% higher* in 2010 than they were in 1990, rather than *down 7%* as required under Kyoto. It may be very difficult to wean ourselves off of fossil fuels with the current US government power structure. Early indications are that Administration energy policy will be friendly not only to the oil and gas industry where the President and Vice President spent portions of their prior professional lives, but also to the coal industry. Possibly, the largest sustained leadership on nuclear energy policy will come from Congress rather than the Administration. Three key pieces of energy legislation have already been introduced by Senators Murkowski, Domenici and Bingaman, all containing provisions favorable to nuclear energy to varying degrees. Something will likely be enacted this year.

Public attitudes towards nuclear power have gradually improved in the United States, and in political circles there is really relatively little anti-nuclear sentiment at this time. Even the Democratic Clinton Administration could be described as having been somewhat pro-nuclear, not actively advocating more nuclear power but acknowledging its importance in the energy mix, especially to avoid greenhouse gas emissions, and initiating important R&D programs to address the barriers to further additions of nuclear generation.[20] And of course there has been no discussion at all of a phase-out or even a moratorium on new construction, unlike in European countries, though some states including California do have laws barring further nuclear construction on economic grounds. The principal focus of anti-nuclear groups has been the proposed nuclear waste repository at Yucca Mountain, Nevada. New construction of nuclear plants will certainly raise opposition, even though the new technologies offer safety improvements. There is some risk that if the Bush-Cheney Administration, which is viewed as very partial towards industry in general and against environmental protection, promotes the nuclear option too forcefully and in its first months in power, the public will be less convinced that it is based on a careful review of the advantages of these advanced designs.

---

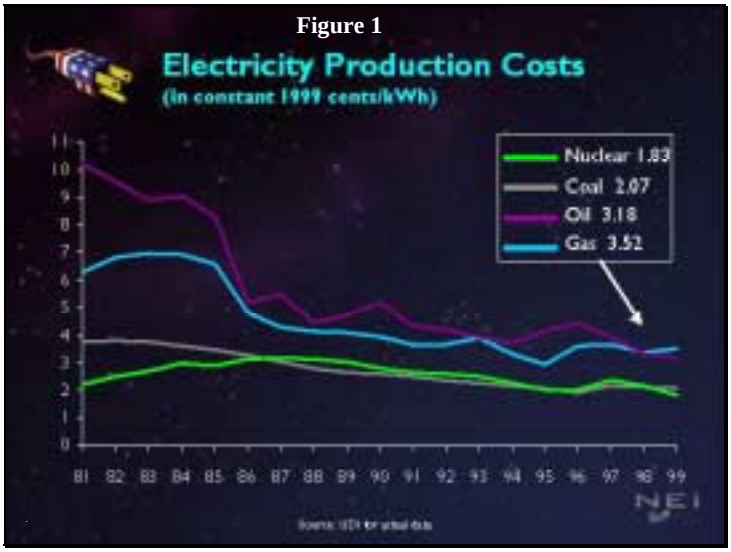
[19] "Global Warming has Bush on the Hot Seat," *Business Week,* April 9, 2001, page 76.

[20] President Clinton's Committee of Advisors on Science and Technology (PCAST) wrote in 1997 that increased funding was needed in the areas of energy efficiency, fission, fusion and renewables. PCAST said that the expandability of fission was in doubt due to concerns about cost, accident risks, waste management and proliferation. According to PCAST, because of fission's potential benefits in addressing the CO2 challenge, "it is important to establish fission energy as a widely viable and expandable option if this is at all possible."

Let me state in closing that there are progressive, technology-oriented solutions to electric power production which have the potential to provide great advantage over the burning of fossil fuels, a practice which was established in the 19th century and has caused extensive environmental degradation and public health impact. I would submit that nuclear advocates are technological optimists many of whom are equally interested in seeing the success of renewable energy technologies, efficiency improvements, and good practices both in the electric power and the transportation sectors. Nuclear advocates should not dismiss the potential role of renewables – which in fact can be significant when one examines the numbers -- but rather seek ways to promote both together. The nuclear industry should help the renewables/efficiency industry and they may help nuclear in return, as these industries support society in the long journey to phase out the use of fossil fuels.

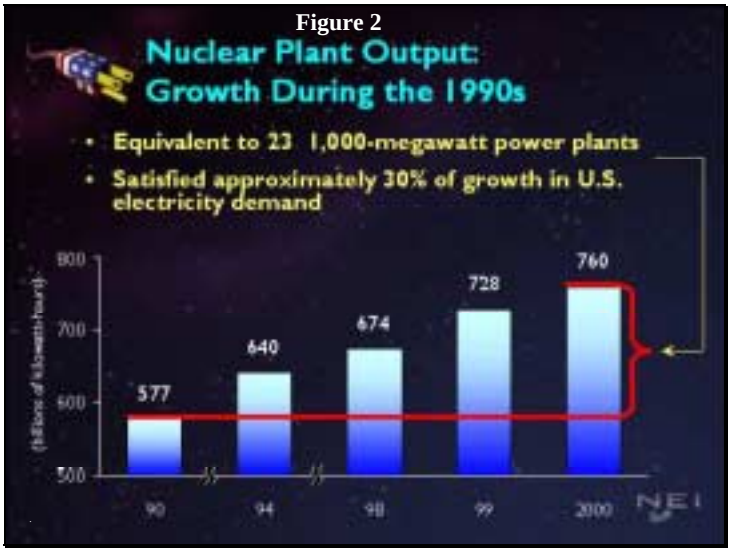
Slide 1

Figure 1



Slide 2

Figure 2



Slide 3

Figure 3

Slide 4

Figure 4

THE NEW U.S. NUCLEAR POWERS:
Companies/Alliances That Will Be
Running the Nation's Nuclear Fleet
After All Consolidations Announced To Date Take Effect

ENTITY	NUMBER OF NUCLEAR UNITS
Exelon Generation Company [1]	20[2]
Entergy	9
STARS Alliance [3]	8
Nuclear Management Company [4]	8
Duke Power	7
Dominion Generation	6
Southern Nuclear Operating Company	6
Tennessee Valley Authority	6[5]
Carolina Power & Light/Florida Power Corp.	5
Constellation Nuclear	4
First Energy Nuclear Operating Company	4
FPL Group	4
Arizona Public Service Company	3
Public Service Electric & Gas	3
American Electric Power	2
PPL Corporation	2
Southern California Edison/San Diego Gas & Electric	2
Detroit Edison	1
Energy Northwest	1
Nebraska Public Power District	1[6]
North Atlantic Energy Service Corp.	1[7]
Omaha Public Power District	1[6]
Rochester Gas & Electric	1
South Carolina Gas & Electric	1

Slide 5

Footnotes to Figure 4:

[1] Merger of Unicom and PECO Nuclear.

[2] This number includes two shutdown units (Zion), as well as four units owned or soon expected to be owned by AmerGen, a joint venture of PECO Nuclear and British Energy.

[3] STARS is not an operating company, but an alliance among several operators for improved staffing efficiencies and procurement economies. However, member companies' executive management may decide to form an operating company in the future. Member companies include Ameren/UE Corp., TXU Electric, Pacific Gas & Electric, South Texas Project Operating Co., and Wolf Creek Nuclear Operating Co.

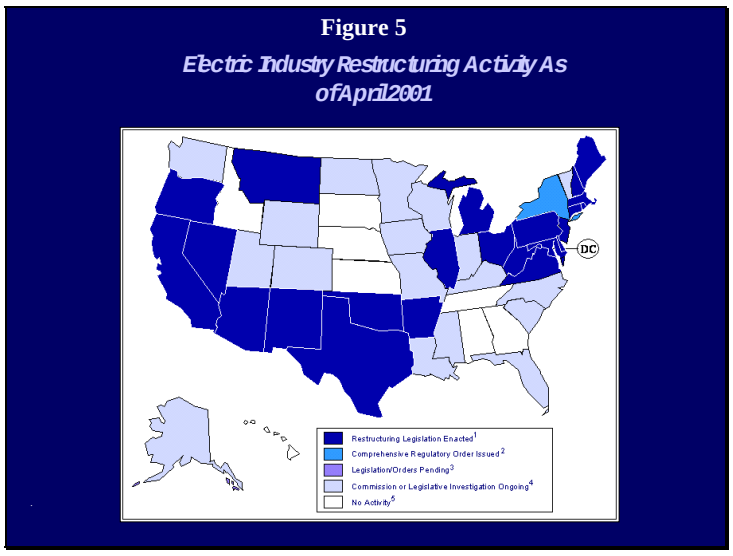
[4] A non-owning operator that now holds licenses of nuclear units of participating utilities.

[5] This number includes one shutdown unit (Browns Ferry). It does not include three partially-completed units (two at Bellefonte and one at Watts Bar).

[6] The Nebraska and Omaha Public Power Districts have established a joint task force to consider the possible formation of a joint operating group. The task force will report to the two boards by April 2001.

[7] Unit currently up for sale.

Slide 6



Slide 7

Figure 6

Past and Present U.S NRC Approvals of Thermal Power Uprates At Operating U.S Reactors

Uprate % (of Originally licensed thermal power limit	Already Approved Units	Currently Pending Units
>10%	4	0
5-10 %	42	5
1-5 %	4	1

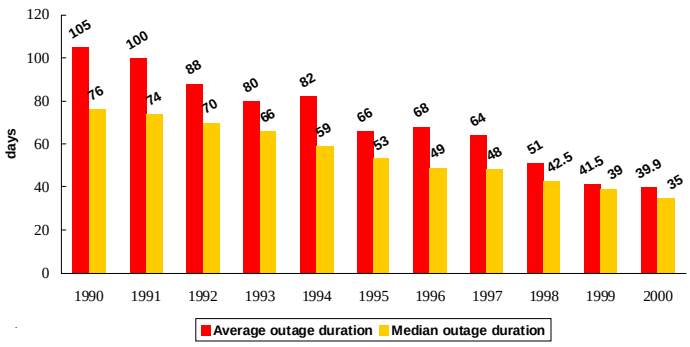
Source: U.S Nuclear Regulatory Commission Staff, September 18th, 2000.

Numark Associates, Inc. *April, 2001*

Slide 8

Figure 7

Average & Median Duration of Nuclear Refueling Outages in the US (1990-2000)



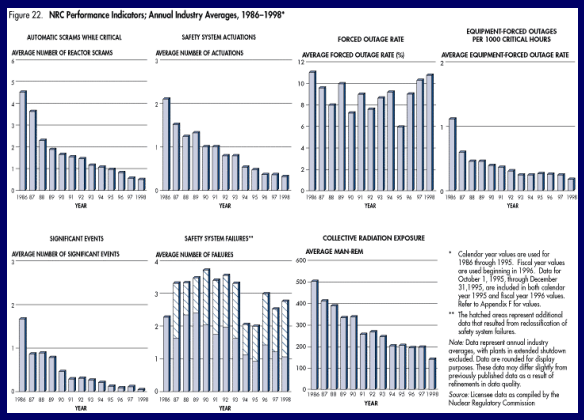
Source: Institute of Nuclear Power Operators (INPO)

Note: Values do not include data from shutdown units

Slide 9

Figure 8

NRC PERFORMANCE INDICATORS; ANNUAL INDUSTRY AVERAGE, 1986-1998



Slide 10

Figure 9