

TO: John Holdren

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RE: Harvard workshop agenda: Responses to several of the proposed questions

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**1. Can nuclear power be competitive in a deregulated market?**

Yes. Substantial improvements have been made in recent years which put nuclear power production costs on a competitive footing:

- Plant capability factor (a measure of capacity factor) has increased from a national average of 63% in 1980, to 72% in 1990, to 82% in 1994 through 1997; and
- Production costs (operations, maintenance, and fuel) have fallen to an average of 1.91 cents/kWh in 1996, as compared to 2.63 cents/kWh in 1990 (an increase of a few percent occurred in 1997).

But there is significant uncertainty as to how much of the present nuclear capacity can compete economically. The uncertainty arises primarily from two sources:

- the degree to which nuclear plant stranded assets will be handled by state regulators. (California has set an encouraging precedent in this regard); and
- the degree to which consolidations of nuclear generating capacity will be effected so as to reduce high overheads, particularly for single-unit plants owned by a single company.

Even if both of these issues are resolved reasonably favorably, my guess is that about 15% of present capacity will be shutdown prematurely (close to the 85 GWe you suggest as a potential goal for nuclear capacity in 2012).

**2. Should we care if 30-50 gigawatts of nuclear power capacity is prematurely retired?**

Yes. Nuclear power has two unique characteristics: zero combustion emissions, and highly concentrated energy. The first frees it from air pollution and greenhouse gas emission concerns and their related costs of emission controls, the imposition of carbon taxes, or the costs of price-imposed externalities. The second frees it from massive fuel logistic support, making it more robust in the event of climatic upsets. A severe reduction in nuclear power capacity will imprudently reduce the existing flexibility, and therefore the reliability, of electricity supply.



**3. What (if anything) should the government do to maintain the nuclear option, and why?**

First, the "why":

There are major internationally-oriented national policy goals given high priority by this Administration, many of which have strong bipartisan support. Maintaining the nuclear option is key to successful achievement of these goals: assuring the safety of nuclear power internationally (particularly in the former Soviet Union), minimizing the risk of nuclear weapons proliferation from internationally based commercial nuclear power activities, disposing of excess nuclear weapon materials, and reducing the level of greenhouse gas emissions worldwide. The ability of the United States to influence favorably the direction of these issues depends crucially on the technological leadership that comes from a healthy nuclear power industry and a strong national laboratory structure. The United States must have a "seat at the table" of industrial activities to influence safety and non-proliferation standards. It should have U.S. nuclear plants for the long term task of burning up excess weapons HEU and possibly plutonium, and to reduce greenhouse emissions per unit of energy consumed.

International trade in safe and non-proliferating, peaceful-use technologies is vital to U.S. economic interests as well as to its strategic position in nuclear policy matters. U.S. vendors bring the highest standards, fully consistent with NRC regulations, as does the Institute of Nuclear Power Operators (INPO) through its in-depth involvement with the World Alliance of Nuclear Operators, to the urgent task of upgrading the safety of Soviet-designed reactors. Loss of the ability to offer the best and safest technology on the commercial market creates an opportunity for trade in less safe designs and less proliferation-resistant technologies, undermining the nuclear Non-Proliferation Treaty.

Second, the "what":

The primary burden of maintaining the option remains with the industry, involving the measures discussed under the first question. Since the U.S. government has a strong interest that the industry succeed, as outlined in the above two paragraphs, the first action needed from both the Administration and Congress is to change the perception that they have no interest in maintaining the nuclear power option. The decision of the Congress last year to zero out the anemic nuclear energy R&D budget proposed lethargically by the Energy Department sent a strong message that this is not a perception, but a reality.

The President's Committee of Advisors on Science and Technology (PCAST) is to be commended for the recommendation in its 1997 report to restore DOE nuclear energy R&D to modest levels in FY 1999 and beyond. This recommendation largely determines the "what" that the government should do technically in light of the fiscal and political limitations involved.

Action by the government is also needed on license renewal, which is covered in responding to the next question. If the United States remains silent on the possibility of relicensing, what incentive will plant owners have to keep investing in upgrades to their facilities? For the time



being, the incentive will remain about the same as the existing incentive to minimize incremental capital investment, consistent with maintaining safety and reliability, to help reduce bus bar nuclear plant costs. But as the present licensed period nears, the incentive will fall to zero as projections show that the plant will not operate long enough to obtain a reasonable return on the incremental investments. Thus, without license renewal, the existing nuclear plants will not operate through the full forty-year license period if safety demands significant capital additions.

A dependable and cost-effective license renewal process is urgently needed. The improvements that NRC has made to its original process (rejected by the utilities as unworkable) have encouraged a few utilities to submit application for license renewal: Baltimore Gas&Electric is on the verge of making the first submission, Duke Power has plans to follow in the near future, and the Southern Company is planning a submission next year. But most utilities are still dubious that the process is sufficiently well defined to warrant the substantial investment required. The NRC Commissioners have expressed strong support for license renewal but will need to establish a timely methodology by which open licensing issues are resolved. In addition, the Clinton Administration should express the strong need for license renewal in view of its Kyoto commitments, which require maintenance of existing U.S. nuclear power capacity.

#### **4. Will competition affect the reliability or operating safety of nuclear power plants?**

There has been a strong movement among the nuclear utilities over the past decade or more to reduce their costs, including improved operations, higher performance, increased availability, stronger management, and staff downsizing. This movement has been moderated by a recognition by plant management that a reduction in safety or a non-compliance in licensing creates increased costs and lower availability of much greater magnitude than the benefits from these improvement programs.

During this period, both the NRC and the Institute of Nuclear Power Operators have monitored the industry very closely, and have acted to curtail operations if a utility's actions have even threatened a reduction in safety. NRC SALP ratings are generally higher for plants operating at lower costs and higher plant availability. The INPO Performance Indicators, which measure average safety-related systems performance, show substantial improvement in this time frame. While costs have come down and capacity factors have gone up, these indicators show that:

- the unplanned automatic scram rate has dropped from 7.3 scrams per seven thousand hours critical in 1980, to 1.9 in 1988, and to 0.8 in 1996 and in 1997, versus a year 2000 goal of 1.0;
- the safety system performance indicator (a measure of the availability of key accident mitigation systems) has risen from 70 % in 1989, to 94% in 1997, versus a year 2000 goal of 85%;
- the fuel reliability indicator has increased from 46% of plants with zero fuel defects in 1989, to 83% in 1997, versus a year 2000 goal of 85%;
- the collective radiation exposure indicator (man rem per plant) has dropped for PWR plants from 417 in 1980, to 273 in 1990, to 124 in 1997, versus a year 2000 goal of 110. For BWR plants, the measure has fallen from 859 in 1980, to 446 in 1990, to 184 in 1997,



- versus a year 2000 goal of 215; and
- the industrial safety accident rate (accidents per 200,000 worker hours) has dropped from 2.1 in 1980 to 0.45 in 1997.

In sum, the self-interest of utility management, the strict monitoring activities of NRC and INPO, and the encouraging record to date convince me that competition will not degrade safety or reliability of the U.S. operating plants.