NUCLEAR RENAISSANCE? THINK GLOBALLY, ACT LOCALLY

Michael J. Lawrence
International Nuclear Programs
Pacific Northwest National Laboratory

ABSTRACT

There is wide-scale belief in the nuclear industry that we are on the verge of a revival of nuclear power because of the projected large increase in the demand for non-carbon emitting electrical generating capacity. Energy consumption will at least double over the next 50 years as a result of population increase and the very real need to improve the standard of living particularly in developing countries. Growing acceptance of the need to reduce carbon emissions is positioning nuclear energy as a likely candidate to meet this increased demand provided valid concerns about economics, safety, proliferation and waste can be adequately resolved. While economics, safety, and proliferation resistance all can benefit from incremental improvement, a permanent waste disposal solution either exists or it doesn't. If a country cannot identify where it will dispose of its spent fuel or high-level nuclear waste, its further use of nuclear energy can be blocked. A number of countries today have generated significant quantities of spent fuel or high-level waste without firm plans or suitable geology for disposal of this material.

Arms reduction and weapons material disposition agreements between the United States and Russia will eventually require those countries to permanently dispose of immobilized plutonium and mixed oxide fuel produced with excess weapons plutonium. This disposal will occur in geologic repositories with bilateral and international safeguards and, presumably, safety requirements. Both of these countries have large, stable, deep geologic formations. Both are also the countries of origin of the largest amount of nuclear fuel used around the world. With regard to Russia, accepting waste or spent fuel from other countries would provide a necessary source of outside capital to finance their disposal program. It also would allow nuclear power to be a viable option for future electricity production in participating counties and reduce proliferation concerns from this fuel. Once demonstrated as a safe and economical solution, other countries with suitable geology, stable governments and solid nonproliferation credentials could follow suit and provide international disposal capability.

To implement this solution on a global level, we must show leadership locally by providing disposal capability in the United States. A decision on the acceptability of Yucca Mountain is needed now. Unless the United States demonstrates leadership in disposing of nuclear material required through agreement with the Russians or contracts with utilities, there will be widespread negative consequences on the viability of nuclear energy to meet national and global electric demands. In short, there will be no nuclear renaissance.

INTRODUCTION

The global demand for energy will increase substantially over the next fifty years. Estimates on the amount of growth vary from two to three times current levels, even with strong conservation measures. Based on current usage, 30 percent of this increase will be for electricity. Since some existing electric generating facilities will be shutdown during this period, new facilities will be required to meet the demand growth and to replace capacity lost to age, economics or environmental concerns.

While the amount of the increase is subject to debate, the very fact that one third of the world's population does not have access to electricity should be reason for great concern. The gap between the "haves" such as the United States, Western Europe and Japan, and the "have nots" in Africa, Asia, South America and a major portion of the former Soviet Union continues to grow. Countries cannot be secure without the basic needs of clean water (half the world does not have ready access to clean water), a dependable food supply, a safe environment, and ample energy to raise their people up from servile labor. Peace is more than the absence of conflict. It is the national security of having the resources to provide for the basic needs and further development of the national population.

To complicate the challenge of increasing electrical generating capacity, we also must consider the growing acceptance of the need to limit carbon and greenhouse gas emissions. Like future demand, the amount of reduction of these gases needed to curtail and stop global warming is subject to debate. The Kyoto Protocol calls for a 40 percent reduction in emissions from those projected for 2010. But if a diverse mix of energy supply is required for the future for both security and to hedge our bets, then some of these energy sources must emit little or no carbon or greenhouse gases. Solar, wind, conservation, hydro and nuclear should all be viable options if we are to reach our goal.

Given this situation, the nuclear industry cautiously predicts a renaissance for nuclear power, and with good reason. Over the past 10 years, the U.S. nuclear industry has made substantial improvements in operating efficiency, reducing operating costs and improving plant safety. The average capacity factor has increased from 58 percent in 1980 and 66 percent in 1990, to 85 percent in 1999. That's the equivalent of 19 new 1000-megawatt plants, all without any carbon or greenhouse emissions to the environment. Average production costs for nuclear-generated electricity from current plants are less than half the cost from gas before recent dramatic gas price increases.

Finally, another positive development for the advancement of nuclear energy is the emergence of a champion, Senator Pete Domenici of New Mexico. Starting back at Harvard University in October 1997, and updated regularly in speeches since that time, Senator Domenici has clearly and effectively enumerated the benefits of nuclear energy and challenged past decisions which, while well intended, did not produce desired results. More government leaders need to join Senator Domenici if an unbiased evaluation of nuclear energy for future use is to occur.

THE PROBLEM

It is now widely accepted that before nuclear energy production can be selected for further use, it must satisfactorily address four important issues: economics, safety, proliferation resistance and waste disposal. Theoretically, and on paper, all of these issues have solutions. The problem lies in implementation. A relatively new initiative by DOE to develop a Generation IV reactor, which specifically targets these issues, is under way.

Three of these issues -- economics, safety and proliferation resistance -- are matters of degree. Operating costs for nuclear power are now very attractive, but capital costs must be reduced from about $1500-1700/ kilowatt to about $700/ kilowatt. This can be achieved with simpler plants, new construction techniques such as modular, off-site construction and reduced construction times. There is already an outstanding safety record in western designed plants and further improvements are possible with increased reliance on passive safety features and less reliance on active systems and controls. Finally, the once-through fuel cycle is already considered the standard for proliferation resistance, and fuel cycles involving recycle have been identified which preclude the need for separated material. While none of these are easy, they only require incremental improvements.

The same cannot be said for the permanent disposal of high-level radioactive waste or spent fuel. A number of highly respected officials from industry and government have told me that nuclear waste disposal is a straightforward problem with a clear technical solution. They note it is really only a political issue. But when it comes to nuclear energy, political issues may be even more important and certainly more perplexing than technical issues. Remember Einstein's admonition that the use of nuclear energy would be decided in the town square.

Simply put, a disposal capability for nuclear waste and spent fuel either exists or it doesn't. And right now it doesn't. And I do not believe that the issue of spent fuel versus separated high-level waste, or transmuted high-level waste is important. All of these forms, to one degree or another, will need to be disposed of depending upon national requirements, the condition of the fuel, and other technical and political considerations. And the public is highly influenced by the argument that you shouldn't produce additional waste until you can show you can safely dispose of it. The challenge is clear.

The United States and several other countries have active programs to establish geologic disposal capability, but none has actually approved a site, let alone started construction. Assuming eventual success, unless these facilities accept waste from other countries there will still be tens of thousands of tons of spent fuel and high-level waste without a disposal solution. Furthermore, there are a number of countries possessing nuclear waste that may never have a suitable indigenous location for permanent disposal. There will be strong opposition to further use of nuclear energy by countries unless they have an identified means of waste disposal.

While many countries, especially the United States, have been less than aggressive in establishing permanent disposal capability for their commercial spent fuel and waste, there is a real urgency shared by the world in the disposition of excess nuclear weapons material by the United States and Russia. As early as 1994, the National Academy of Sciences stated that excess

weapons-grade plutonium and highly enriched uranium presented a "clear and present danger." While some progress has been made, a March 1998 report by the Center for Strategic and International Studies reconfirmed the Academy's assessment.

Highly enriched uranium from nuclear weapons can be blended down into low-enriched uranium and consumed in light-water reactors. Plutonium, on the other hand, presents more of a problem and cannot be readily blended. A hybrid approach to Pu disposition was selected by the United States and Russia, whereby weapons plutonium pits would be disassembled and converted into oxide beginning in 2007. The plutonium oxide will then be either fabricated into mixed plutonium and uranium oxide fuel elements for burning in existing light water reactors or the plutonium oxide will be embedded into a ceramic matrix to form pucks. The pucks will be stacked into steel cans that are then arrayed inside canisters into which molten high-level radioactive waste is poured.

Both Russia and the United States have each agreed to dispose of 34 metric tons of weapons material beginning in 2007 at an initial rate of two tons per year. The mixed-oxide fuel will be cycled once through a reactor before being ready for disposal. Once irradiated, the MOX fuel and the high-level waste canisters containing plutonium pucks will have to be stored until disposal capability is available. There will be growing international pressure to get on with disposal to ensure this material is never reused for weapons. The United States and Russia would benefit from the minimization of storage and inspection costs.

To carry out this disposition strategy the U.S. is leading an effort to provide technical and financial assistance to Russia. With many pressing domestic needs, the Russian economy is not readily able to pay for the plutonium conversion and storage and disposal facilities. The world community also is concerned that these facilities be built to western safety standards. It would be highly desirable for Russia to establish a means to self-finance its plutonium disposition capability and facilities.

THINK GLOBALLY

Both the United States and Russia have a clear need for permanent disposal capability for their commercial nuclear waste and spent fuel, and their excess weapons material either as immobilized plutonium or spent MOX fuel. The sooner this capability is in place and available, costs for interim storage can be avoided and one of the four major impediments to the use of nuclear energy in their countries can be removed. A major step toward disarmament also will be achieved as the world witnesses and verifies that weapons useable material has been permanently disposed in a geologic repository.

The United States and Russia also were the leading countries in providing enriched uranium around the world as they exported nuclear energy to other countries, many of which are without capability to dispose of their waste within their borders. An argument can be made therefore that both the United States and Russia have at least a moral obligation to these countries to help them dispose of their nuclear waste, either in Russian or U.S. repositories, or help establish other means of international disposal. If this were done, these countries would likewise have a major impediment removed from their further use of nuclear energy.

The nonproliferation and weapons disposition agendas of the United States and Russia would mutually benefit from the permanent disposal of weapons usable material. An added benefit to the Russian program would be the potential to generate very large revenue from the disposal service that would finance their weapons disposal efforts and generate additional income for either environmental or social programs. In December 2000, a Duma committee had the first reading of a bill that could become law by the end of 2001 to lift a ban on the import of foreign spent fuel and storing waste from other countries. The Russian Ministry of Nuclear Energy supports the bill and estimates that $20 billion could be earned over the next 20 years in the nuclear fuel recycling and storage business. While it is not clear if this estimate includes disposal, Russia and the countries receiving the services would both benefit from the service. Russia has indicated that $7 billion of the revenue would be devoted to environmental protection.

Given the Soviet Union's disastrous record in managing its own radioactive waste, as well as the Chornobyl accident, many will be, at the least, skeptical of the safety of sending spent fuel and waste to Russia for disposal. But Russia is not the Soviet Union, and Russia today has a vigorous green movement and is steadily improving its safety establishment with western help. It is quite likely that international safety standards as promulgated by the International Atomic Energy Agency (IAEA) in the International Safety Convention would be applied to any international disposal facility.

While U.S. and Russian services would be a very important step forward, it is likely that additional international disposal capability would be needed. The Pangea Project has been looking to establish an international geologic disposal facility and is currently evaluating the feasibility of a western Australian site. While this and other efforts face an uphill battle with a politically incorrect issue, they have the strength of addressing real environmental and security problems with practical and technically sound solutions.

To achieve the environmental, nonproliferation and energy benefits that international disposal capability offers we must stop the polarization of this issue. Proponents view the establishment of international disposal capability as a means to revive and expand the use of nuclear energy and to reduce carbon and greenhouse gas emissions, plus as a means to finance the permanent disposal of excess weapons material. Opponents see it as a means to dump nuclear waste on others for profit. Unsolvable problems would be swept under the rug and we would perpetuate our use of a failed technology. A more moderate assessment would be that international disposal capability provides an option for disposing of waste and excess weapons material, under international standards, and enables nuclear energy to remain as a viable option for meeting future electricity demands without global warming consequences.

ACT LOCALLY

Despite the multiple needs for international nuclear waste disposal services, I clearly recognize the enormous obstacles that establishment of these services face. If we fixate on the long range and ultimate outcome, I believe we will not be successful. Instead we must focus on those actions which are our responsibility and are within our control. By definition, these are local, U.S.-based actions.

Make a decision on Yucca Mountain

We have been investigating the Yucca Mountain site for two decades. The Nuclear Waste Policy Act of 1982 required a repository to begin accepting commercial waste by 1998, and utilities have been paying their ratepayers funds into the program since 1983. Not only does the repository not exist, we've yet to decide if Yucca Mountain is suitable. A decision is planned for late this year and we need to ensure it is made. If Yucca Mountain is suitable, licensing and construction should proceed as quickly as possible and spent fuel and waste could be moved to the site in anticipation of its opening. If Yucca Mountain is not acceptable, we need to quickly focus on a likely candidate site in a salt formation similar to the formation found suitable for transuranic defense waste at the Waste Isolation Pilot Plant (WIPP). Legal prohibitions exist from disposing of high-level waste in WIPP, but that doesn't mean that this facility, or one just like it, couldn't safely and relatively quickly be used for disposal.

Proceed on Pu Disposition and Include Disposal

The United States must maintain its strong commitment to nuclear arms reduction and the removal of weapons usable material from the stockpile. While Congress has tied U.S. weapons material disposition to similar progress by the Russians, President Bush has stated his commitment to unilateral arms reductions. But we need to make sure we do not make the same mistake that we have been making ever since the Manhattan Project and stop with "interim" storage of the waste, or in this case, excess material. We must include permanent disposal if we are to permanently rid ourselves of this material.

Establish an International Study on International Disposal Requirements

In 1953, President Eisenhower's Atoms For Peace speech to the United Nations General Assembly called for sharing the benefits of nuclear energy with the rest of the world and to establish an "international atomic energy agency" to take possession of fissionable material and allocate it to serve the peaceful pursuits of mankind. He suggested the "Atomic Energy Agency could be made responsible for the impounding, storage and protection of the contributed fissionable and other material." Had we followed through on President Eisenhower's suggestion we could have avoided a number of problems that still face us today. We need to revisit his suggestion and promote an international one-year study by an international commission and supported by the IAEA of the requirements and protocols necessary for international waste and spent fuel disposal services. To be successful, this study must not have any preconceived conditions or biases, other than fundamental safety and peaceful use requirements.

CONCLUSION

Solving the nuclear waste disposal problem and providing international services will not enable a nuclear renaissance to occur. A disposal solution is necessary, but not sufficient. Other issues also must be assessed and nuclear must be accepted by the public as a viable option for future use. But without a solution to the nuclear disposal problem in this country and, ultimately, the rest of the world, it is highly unlikely that nuclear energy will be allowed to contribute in a significant way to meeting future energy demands and reducing the threat of global warming.

We can no longer stick our heads in the sand and pretend that a global problem does not exist, or rant that the anti's and the media exaggerate the risks and dangers of nuclear waste. We must address the problem and provide solutions. It will take both leadership and courage. And it needs to begin here and now.