

Nuclear Imperatives

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I. Introduction.

It is an honor to speak to such an expert group, with such deep and varied experience. Given that expertise and experience, it is unlikely that I can say anything that has not already been thought of by at least some, if not all, of the participants in this conference. Nonetheless, I will try to crystallize the most important challenges we face in the realms of nuclear energy and proliferation, review some of the solutions which are being proposed and implemented, and try to stimulate discussion with an optimistically contrarian view. This last position is provisional; I am trying to test ideas through discussion and debate.

II. Importance of Nuclear Power.

We, the participants in this conference, are struggling to answer to some of the most important and vexing questions of our time. How do we simultaneously:

- meet growing demands for energy, necessary for economic growth and bringing prosperity to more people; while,
- reconciling these requirements with the need to curtail greenhouse gas emissions, and lessen our dependence on oil from unstable regions in the world?

According to the U.S. Department of Energy: “World net electricity generation [will] nearly double . . . , from about 17.3 trillion kilowatt hours in 2005 to 33.3 trillion kilowatt hours in 2030.”¹ (The current financial crisis will delay, but will not likely halt this growth in demand.)

Even strong advocates of nuclear energy admit that the atom alone, cannot solve our energy needs. Renewable sources—solar, wind, biofuels—must make up an increasing share of the world’s energy balance. Nonetheless, even some of nuclear energy’s most ardent critics of the past, are also coming to realize that these sources cannot reliably meet the increasing demands of large, modern cities.

There are currently 104 commercial nuclear power reactors operating in the United States. In 2007, they generated almost 20 percent of U.S. production. Because of the age

of the U.S. nuclear reactor fleet, just to maintain today's level of output will require construction of at least a dozen plants between now and 2030.

The U.S. Nuclear Regulatory Commission has received applications for 26 combined construction and operating licenses for nuclear power reactors,ⁱⁱ and 21 companies have announced plans to build a total of 34 reactors.ⁱⁱⁱ While virtually no one expects all these announced plans to be fulfilled, because of financing or other issues, there will also be significant new pressures for increased construction.

According to the Department of Energy's Nuclear Energy Advisory Commission, action to limit carbon emissions could accelerate new reactor construction:

“If a significant price were placed on carbon dioxide, either through a carbon tax or a cap-and-trade system, nuclear power expansion could be much greater assuming continued increases in GNP and electricity demand. Under these circumstances, a new deployment of up to 45GWe by 2030 could be considered”^{iv}

Overseas there are some 335 nuclear power reactors operating in 30 jurisdictions, with a combined capacity of about 270 GWe. In 2007 these provided about 16% of the world's electricity.^v

Forty-four power reactors are currently being constructed in thirteen jurisdictions. The pace of new reactor construction is faster and accelerating, vs. that of the United States. The International Atomic Energy Agency now forecasts at least 60 new plants in the next 15 years.^{vi}

Given these ambitious projections, it is reasonable to question whether such growth is sustainable, given limited manufacturing and construction capabilities. According to the World Nuclear Association:

“It is noteworthy that in the 1980s, 218 power reactors started up, an average of one every 17 days. These included 47 in USA, 42 in France and 18 in Japan. The average power was 923.5 MWe. So it is not hard to imagine a similar number being commissioned in a decade after about 2015. But with China and India getting up to speed with nuclear energy and a world energy demand double the 1980 level in 2015, a realistic estimate of what is possible might be the equivalent of one 1000 MWe unit worldwide every 5 days.”^{vii}

Thus, today nuclear power plays an important economic role and there is every reason to believe that it will only expand in the future. How we manage that expansion will affect our prosperity, our safety, and our security.

III. Assessment of the Proliferation Threat.

Perhaps the foremost issue arising from the worldwide growth of nuclear power is the threat of nuclear weapons proliferation. We have seen recent and dire predictions of a great many more nations wielding nuclear weapons.

American statesmen Henry Kissinger, George Shultz, William Perry, and Sam Nunn warned recently that: “The accelerating spread of nuclear weapons, nuclear know-how and nuclear material has brought us to a nuclear tipping point. We face a very real possibility that the deadliest weapons ever invented could fall into dangerous hands.”^{viii}

Since September 11, 2001, the candidates nominated by major parties for the U.S. presidency have unanimously cited nuclear proliferation and terrorism as the main threats to international security.

To overcome our worst fears, we must understand them. The threat of nuclear proliferation is acute, but not yet widespread. It is limited to a very few countries, although the actions of those countries may have broader implications for the decisions by others. While we must always be seeking ways to strengthen the international nonproliferation system, we should also not ignore the importance of specific solutions to the specific threats to that system.

North Korea is a serious threat to the international nonproliferation regime. It violated, and then withdrew from the Nonproliferation Treaty. It has produced plutonium, which can be fabricated into nuclear weapons. It has conducted two nuclear tests. It has exported ballistic missile and nuclear technology. There are, however, reasons to believe that we can address the threat from Pyongyang. North Korea is economically and even militarily weak relative to its neighbors. By any reasonable measure it is a failed state, unable to provide the barest of necessities for its people. Its stability depends on the ruthlessness of a single dictator, but that man is mortal.

The greatest threat from North Korea is that it will export nuclear material or weapons to a terrorist organization or an outlaw state acting outside the Nonproliferation Treaty. That threat can be addressed by a two-fold policy. First, enhancing capabilities to ensure that any nuclear material or weapons exported by North Korea could be accurately detected and attributed to their source. And, second, by making clear that Pyongyang would be held fully responsible for any consequences of such exports, no less than if a North Korean had launched or detonated a weapon. Ideally, both of these policies would not be limited to the United States; they would enjoy support from as many governments as possible.

After North Korea, Iran poses the most immediate threat to the nonproliferation regime. In many ways, it is a more complex and serious threat. Iran is large and powerful relative to its neighbors. It sits astride a region of great economic importance. It is not as isolated as the “Hermit Kingdom.”

In 2003, revelations of seventeen years of clandestine work toward a uranium enrichment capability destroyed any international confidence that Tehran's program was for peaceful purposes. In September 2005, the International Atomic Energy Agency (IAEA) Board of Governors found that Iran had violated its Safeguards obligations and later reported the matter to the United Nations Security Council. Since then, the International Atomic Energy Agency, the United Nations Security Council, and the so-called P-5 plus one nations, have variously encouraged, demanded, and implored Tehran to take action that could restore such confidence. So far, none has been forthcoming. Whether the Obama Administration's new, more conciliatory approach toward Iran will succeed remains to be seen.

Does this mean that no solution is possible, that we face a cascade of nuclear proliferation propelling us into an abyss of atomic anarchy? Not inevitably. The same principles that served us in the past, can help to protect us in the future. Respect for international law, collective action to defend international security, and yes, nuclear deterrence in service of international security and nonproliferation, may well avert a nuclear calamity in Iran.

A few other threats also bear watching. For example, Syria, with North Korean help, managed to construct a covert nuclear reactor well suited for plutonium production. While that reactor is no longer a threat, the International Atomic Energy Agency must be allowed sufficient access to ensure that no military nuclear program remains in Syria.

These are acute threats to the nonproliferation regime. That three of 192 United Nations member states may have acted in violation of the NPT and that three others remain outside the Treaty, however, does not guarantee an avalanche of proliferation. Moreover, international cooperation can diminish motivations for further proliferation, prevent it from cascading out of control, and eventually reverse it.

At various times over the past six decades, there have been nearly twice as many active nuclear weapons programs abroad in the world as exist today. Some countries ended these programs with no fanfare. In other cases, the developments were more dramatic. For example, Belarus, Kazakhstan, and Ukraine voluntarily gave up their nuclear weapons capabilities after the Soviet Union dissolved. South Africa abandoned its nuclear weapons and Libya gave up its clandestine nuclear program. All this is to say that an endless ratcheting of the proliferation threat is not inevitable, and that if it does increase, it can be reversed.

It needs also to be said that some analysis of proliferation issues is flawed because it ignores the logic of Thomas Bayes, the 18th century minister and amateur mathematician. Bayes recognized that conditional probability is not necessarily symmetrical between two events. In other words, the probability that A will occur if B occurs will often differ from the probability that B will occur if A occurs.^{ix}

How is Bayes related to nuclear proliferation? His logic helps to reveal the fallacy of assuming that more countries with civil nuclear energy programs will lead inevitably to more countries with nuclear weapons. Just because most nuclear proliferators attempt, at

least for a time, to hide their military ambitions under the guise of peaceful nuclear programs, does not mean that most or even any countries pursuing peaceful programs are in fact proliferators. North Korea did not develop a nuclear weapons program because it had a research reactor; it has a plutonium production reactor because it has a nuclear weapons program.

The reasons that drive nation states to build nuclear weapons programs are complex and varied; they entail a great deal more than the presence or absence of a civil nuclear energy program.

Moreover, despite their protestations to the contrary, the programs of proliferation concern in North Korea, Iran, and Syria lack a credible connection to nuclear energy. The Yongbyon reactor can barely provide enough power for its immediate surroundings, let alone materially affect North Korea's electricity supply. Iran's enrichment program would make more sense if fuel for its sole power reactor were not already under contract with Russia. The Syrian nuclear reactor was apparently not connected to the local grid.

In summary, the threats to the Nonproliferation Treaty are acute, but limited; the number of states that pose a credible threat to the nonproliferation regime is, for now, diminishing rather than increasing; we need tailored solutions to meet those threats; and, we must not confuse the fact that proliferators hide behind civil nuclear programs, with a false assumption that greater use of civil nuclear power will lead inevitably to proliferation.

IV. Building Barriers to Proliferation.

Science and technology, policy initiatives, and economics can all contribute to barriers to nuclear proliferation.

In the world of science and technology, we need to reenergize our efforts. Just as civil nuclear energy efforts lay fallow in the United States after the Three Mile Island incident three decades ago, so too did our efforts to advance nuclear safeguards. The scientific pioneers of nuclear safeguards are nearing or in retirement. We need to train a new generation of leaders to advance a new generation of technologies to meet 21st century requirements. Last year, the U.S. National Nuclear Security Administration launched the Next Generation Safeguards Initiative to advance work in this area. The scientific community can also contribute to improved methods for managing the fuel cycle, from enrichment to spent fuel take-back arrangements, to strengthen barriers to proliferation. Over the longer term, transcendent technologies may improve how we cope with the back end of the fuel cycle in ways that address both our waste disposition and proliferation concerns.

In the policy realm, new initiatives for stemming the threats of nuclear terrorism and proliferation offer ample opportunities for nations to cooperate across the whole spectrum of activities, from export controls, to improved material protection, control, and accounting, to minimizing the use of highly enriched uranium in research reactors, to emergency response. The Global Initiative to Combat Nuclear Terrorism now counts

over seventy members among its adherents. The newly launched World Institute of Nuclear Security is working to do for security what others have already done for safety. It seeks to engender international cooperation among practitioners to elevate the standard of professionalism for an entire industry.

Economics too, can play an important role in building barriers to proliferation. Uranium enrichment programs do not make economic sense, unless they support a relatively large fleet of reactors, the size of which only a few countries possess. We must make a virtue of economic reality, by using it to limit the spread of enrichment technology. The several countries and the International Atomic Energy Agency have recognized this with the proposals and programs for assuring access to nuclear fuel. The sound start that we have made in these areas, from the Russian international fuel center at Angarsk, to the U.S. reserve which will be stocked with 17.4 metric tons of down-blended highly enriched uranium, to the IAEA fuel bank seeded by the Nuclear Threat Initiative, to the six country proposal for assured supply, should be sustained. No nuclear reactor has ever had to shut down for lack of fuel and there is no reason to believe that confidence in supplies should be any lower in the future.

V. Strengthening the Nonproliferation Treaty.

Next year, the states parties to the Nuclear Nonproliferation Treaty will meet again to review the Treaty. Inevitably, there will be proposals and counterproposals, accusations and counter-accusations about how to strengthen and who or what is weakening the treaty.

Much attention has been paid to whether or not the United States and other nuclear weapons states under the Treaty are meeting their disarmament obligations under Article VI. We hear from some that:

“The core bargain of the NPT where states undertook not to aspire to nuclear weapons on the basis that all States Parties would work for their elimination should not be forgotten, as in recent years a great deal of attention has been paid to the threat of nuclear proliferation. Nuclear disarmament and nuclear non-proliferation are inextricably linked, and both therefore require continuous and irreversible progress.”^x

To assert that nonproliferation has received more attention than disarmament, ignores the substantial disarmament that has occurred since the end of the Cold War. In the words of the 2009 bipartisan Congressional Commission on the Strategic Posture of the United States, chaired by former Secretaries of Defense Schlesinger and Perry:

“Over the last two decades, the security environment of the United States has changed considerably and generally for the better. The threat of nuclear Armageddon has largely receded. At the height of the Cold War, the U.S. nuclear arsenal numbered over 32,000 weapons and the Soviet arsenal over 45,000; today,

the United States has reduced its arsenal of operationally deployed strategic nuclear warheads to approximately 2,000 and Russia is not far behind.”^{xi}

Moreover, rather than being composed of single, core bargain between so-called haves and have-nots, the Nonproliferation Treaty is a complex series of bargains, which in general have held up pretty well.

- It was a bargain between nuclear weapons states, particularly in the Cold War context, not to transfer their capabilities to non-nuclear weapons states, and not therefore to expand East-West nuclear competition through proxies.
- It was a bargain between those nations with nuclear technology and those without it to share the benefits of civil applications in electricity generation, medical treatment and diagnostics, food and blood purification, improving agricultural yields without pesticides, and oil and natural gas exploration.
- Significantly, the Nonproliferation Treaty was also a bargain *among non-nuclear weapons states* not to engage in a costly, and ultimately futile, effort to gain security advantage over each other.

While there is no doubt that U.S. security has been enhanced by the Nonproliferation Treaty, non-nuclear weapons states may have benefited even more. Whole regions have been able to avoid both the threat of nuclear-armed neighbors and the expense of costly defense programs. Extended deterrence offered by the United States, in cooperation with its allies, fosters this process. Consider this question: which nation is threatened more by the prospect of a new nuclear weapons program, the United States, with a large array of military forces capable of deterring a wide range of threats, or a non-nuclear weapons state, with more limited capabilities? By joining the Nonproliferation Treaty, non-nuclear weapons states acted together to improve their collective security, and they and the world are safer for it. This is worth remembering, as we hear talk of so-called “haves and have-nots.”

VI. Conclusion.

Nuclear energy has a vital role to play in our energy future. The threats of nuclear proliferation are acute, but limited. Solving them will require effective collective action, but we have succeeded in the past to induce states to give up nuclear weapons programs. The spread of civil nuclear energy programs does not inevitably lead to the proliferation of nuclear weapons programs. The Nonproliferation Treaty has been vital to international security, and its complex series of bargains has generally succeeded.

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- ⁱ U.S. Department of Energy, Energy Information Administration (EIA), *International Energy Outlook 2008*, Chapter 5, Electricity.
- ⁱⁱ U.S. Nuclear Regulatory Commission website, *Combined License Applications for New Reactors*, November, 2008.
- ⁱⁱⁱ Matthew Wald, “Nuclear Power May be in the Early Stages of a Revival,” *New York Times*, October 23, 2008.
- ^{iv} Nuclear Energy: *Policies and Technology for the 21st Century*, Nuclear Energy Advisory Committee, November 2008, p. 8.
- ^v World Nuclear Association, *Plans for New Reactors Worldwide*, August 2008.
- ^{vi} World Nuclear Association, *Plans for New Reactors Worldwide*, August 2008.
- ^{vii} World Nuclear Association, *Plans for New Reactors Worldwide*, August 2008.
- ^{viii} George P. Shultz, William J. Perry, Henry A. Kissinger, Sam Nunn, “Toward a Nuclear-Free World,” *The Wall Street Journal*, January 15, 2008.
- ^{ix} Leonard Mlodinow, *The Drunkard’s Walk: How Randomness Rules Our Lives*, Pantheon Books, New York, 2008.
- ^x Statement by Amb. Abdul Samad Minty at the Second Session of the Preparatory Committee for the 2010 Review Conference of the Parties to the Treaty on the Non-proliferation of Nuclear Weapons, April 28, 2009.
- ^{xi} America’s Strategic Posture: Final Report of the Congressional Commission on the Strategic Posture of the United States, William J. Perry, Chairman, James R. Schlesinger, Vice-Chairman, United States Institute of Peace, Washington, DC, 2009, p. xvi.