Shultz-Stephenson Task Force on Energy Policy

Reinventing Nuclear Power Essay Series

Sustaining American Leadership in the Nuclear Industry

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HOOVER INSTITUTION

SHULTZ-STEPHENSON TASK FORCE ON
Energy Policy

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Hoover Institution Press
Stanford University
Stanford, California
2015

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www.hoover.org

Hoover Institution Press Publication

Hoover Institution at Leland Stanford Junior University, Stanford, California 94305-6003.

First printing 2015

21 20 19 18 17 16 15 7 6 5 4 3 2 1

Manufactured in the United States of America

This essay is part of the Hoover Institution Shultz-Stephenson Task Force on Energy Policy's Reinventing Nuclear Power project, edited by George P. Shultz and James O. Ellis Jr. Please see *http://www.hoover.org/reinventing-nuclear-power* for more information and related works.

The editors wish to acknowledge the constructive contributions made to this series by David Fedor.

Sustaining American Leadership in the Nuclear Industry

John J. Hamre

America is in the middle of a profound revolution in energy economics. With a combination of horizontal drilling, advanced computer modeling, and hydraulic fracturing ("fracking"), energy companies can now tap into the bedrock of hydrocarbon deposits and not wait for millions of years for hydrocarbons to migrate to traditional collection pockets in geological formations. The significance of this cannot be overstated. For fifty years, American energy policy assumed scarcity of supply. We now can see a future when America could become a net exporter of energy to the world. To be sure, there are many ways this could falter. Government policies could seriously cripple the development of these resources. But the path we are now on points to a future of relatively abundant energy resources.

This trend has effectively undercut the modernization of American commercial nuclear power. America led the world to build nuclear power generation facilities. After our 1979 crisis at Three Mile Island, construction on new plants stopped. American nuclear power plant operators responded to the challenge by dramatically improving the safety and efficiency of existing plants. The performance improvements over the past twenty years have effectively "built" more than twenty new power plants by boosting the operating efficiency of the 104—now 99—active power-generation reactors.

Ten years ago, through the Energy Policy Act of 2005, Congress pushed to restart the commercial nuclear power industry by creating a $20 billion fund that would be used to support the "first movers" who would start building new nuclear power plants. This program was delayed by faulty execution in both the Bush and Obama administrations. But the real challenge is found in the fracking revolution, noted above. Nuclear power can compete in the marketplace against gas-fired power plants only if there is an effective "carbon price" imposed on hydrocarbon-based generation facilities. Now that natural gas has become abundant and, for the time being, cheap, there is no effective pure economic case that can be made for new nuclear power plants.

The National Security Imperative

While we cannot make a commercial case for new construction of nuclear power plants, there is a compelling reason why America must remain in the commercial nuclear power business. A commercial nuclear power industry is the bedrock for a nuclear weapons program. Since President Eisenhower outlined America's challenge in his famous "atoms for peace" speech, we have sought to balance the promise of abundant nuclear-generated electricity with the risk of proliferation of nuclear technology leading to nuclear weapons.

To manage this risk, America took the lead in designing a global regime of nuclear security. We crafted binding legal instruments to channel the ambitions of individual countries and we established a framework of monitoring and compliance to enforce the policies. To be sure, the system is not foolproof. North Korea formally joined the Non-Proliferation Treaty (NPT) in 1985 but continued to secretly build nuclear weapons. The country's leaders kicked out International Atomic Energy Agency inspectors in 2002 and in short order detonated a nuclear device. We suspect equally deceptive activities by Iran. But the foundation of non-proliferation has been constructive. Where we had at one time projected dozens of nuclear-weapon states, today there are fewer than ten. Many

countries have commercial nuclear power, but eschew nuclear weapons. The NPT has served us well in establishing these conditions.

The NPT and related institutions and procedures are sustained by American leadership. It was in our core, central interests to sustain a global regime that limited the spread of nuclear weapons. It is still in our interest to do so. But that will change if America abandons nuclear power.

The Globalization of Commercial Nuclear Energy

When America started on the path to build commercial nuclear power plants, nuclear technology was held in the hands of only a few countries—the United States, the Soviet Union, Canada, the United Kingdom, and France. All five states had strong reasons to participate in creating the nonproliferation regime.

Since that time, nuclear competence has spread widely and the industry has become global. America no longer dominates the nuclear landscape. Both General Electric and Westinghouse had to find international partners to sustain operations. South Korea has become a very strong competitor. China is developing an indigenous design, no doubt with ideas pilfered from the West. Russia is actively competing to sell new reactors. India could well enter the market with its own original design. And supply chains have become global. Just three vendors—AREVA, Westinghouse, and Global Nuclear Fuel—dominate the market for sale of enriched uranium to power these plants. Reactor components are sourced internationally.

The center of gravity on commercial nuclear power is shifting away from America and Europe toward Asia. This trend is caused by nuclear power becoming a mature technology and by growing apprehension on the part of Europe about the safety of nuclear power. The trend was accelerated by the 2011 tragedy in Fukushima, Japan. Within weeks, Germany, Italy, and Switzerland renounced nuclear power. The new

French government has adopted a skeptical posture, reversing a long-standing French government commitment to be a champion of commercial nuclear power. Japan, with its essentially Western-oriented nuclear regime, struggles to find its bearings after Fukushima.

But work proceeds in China, South Korea, Russia, and India. Countries throughout the Middle East are signing up for commercial nuclear power. While the forecasts projected five years ago are down, there is still likely to be a considerable build-out of commercial nuclear power plants in Asia and the Middle East, met by suppliers in South Korea, India, Russia, and, soon, China.

The chief architects of the nonproliferation system—America and Europe—will become increasingly marginal players in the commercial nuclear power industry. In twenty-five years, America may drop from operating 25 percent of the world's reactors to less than 5 percent. Yet our national security interests in sustaining the nonproliferation regime will grow stronger. Like it or not, America must remain in the commercial nuclear power business if it is to be a global leader in shaping the security environment we face.

A Technology Opportunity

For the past thirty years, the technology trends in commercial nuclear power design have been toward larger reactors. In the past five years, however, we have seen the rise of something called small modular reactors (SMRs). This is an entirely different concept in commercial reactors. We have operated small reactors for years in US Navy submarines and aircraft carriers. In this instance, small reactors (on the order of 150 megawatt reactors, rather than 1,500 megawatt reactors for large installations) would be ganged together to create larger installations. Smaller reactors would feed into individual or larger shared balance-of-plant assemblies for power generation. The SMRs would be built in a factory with economies of scale and transported to a construction site for relatively quick installation. According to advocates of SMRs, the

construction time can be cut in half or even less compared to purpose-built large reactors.

SMRs also offer the theoretical promise of replacing obsolete coal-fired power plants. A single SMR could replace a large coal-fired plant, producing carbon-free electricity, without necessitating a restructuring of transmission lines. (The question of neighborhood acceptance of SMRs has yet to be tested.)

SMRs Still Require a Government Mandate

If the promise of SMRs is true with dramatically reduced construction times, there is still only a weak economic case to be made. Abundant natural gas will be with us for years, and a gas plant can likely be built in half the time of that required for an SMR plant. On that basis, the commercial case could remain weak for decades. But the national security case is strong today and will strengthen.

Our current nuclear power industry is directly the product of US government incentives. The US government wanted a strong commercial nuclear power industry to complement requirements in national security. More broadly, it also believed in the promise of abundant, inexpensive electricity from nuclear plants. For the next chapter of American civilian nuclear systems, the government mandate will have to shift, but it is still real and important.

For example, there is a growing appreciation that America's public utilities are vulnerable to cyber-disruption. There is mounting evidence that power grids and power-generating facilities are vulnerable to remote manipulation. The control of these plants and distribution networks is managed through electronic control systems which were once self-contained, but increasingly have been converted to Internet-based access. Sophisticated hackers now know how to access, manipulate, and destroy power grids and power plants.

Fifty years ago, America's military installations had self-contained power-generation capabilities, but this has changed. Pressure to find

more cost-effective ways to secure electricity led to the closing of most government power plants, shifting operations to commercial networks. America's most sensitive installations still have emergency on-site power generators for key functions; but broadly, America's national security infrastructure is vulnerable to cyberattack through disruption of commercial power grids.

The Obama administration has acknowledged this vulnerability, but the administration has also pushed for non-hydrocarbon sources of power generation. Solar power and wind power are being pursued on US government installations, but neither of them represents a solution for around-the-clock base load power. With wind power limited to 30–40 percent of the day and solar power often less than that, neither is adequate for fundamental national security requirements.

SMRs offer a unique opportunity. While even the smallest SMRs would generate more electricity than is needed immediately on most military installations, the excess power generated can be shared locally with other national security installations, or potentially with local law enforcement and emergency response organizations. SMRs represent a uniquely suitable solution to a growing national security vulnerability.

The Way Ahead

In sum, SMRs will not find their way to production solely through commercial demand. They will require a government mandate. SMRs also are needed to provide reliable base power generation for critical national security installations. The issue now is the way ahead.

Fortunately, the Department of Defense has a highly competent organization that is familiar with small reactors—Naval Reactors (NR). There are almost equal numbers of navy reactors and commercial nuclear reactors in America, though obviously the navy reactors have much reduced output. NR is a highly competent and disciplined organization that knows how to design reactors, bring them into production,

and manage the complex details of program integration. NR could be given the federal responsibility to produce SMRs for critical national security installations on an accelerated basis.

NR would not want to operate these reactors on an ongoing basis, and it should not do so. Rather, these operations should be placed with the private sector, under the supervision and direction of NR. Meanwhile, the Department of Defense would enter into long-term (e.g., twenty-five-year to thirty-year) power purchase agreements (PPA) for output from these company-owned and -operated reactors on military installations. This approach would harness both the efficiency of the private sector and the predictability of government requirements, similar to the delivery model that is now being used by the solar industry on military bases. With a long-term PPA, the commercial firms can go to private equity markets to secure financing for the construction of the plants. Moreover, at this time of constrained budgets, upfront capital costs can be avoided for the government.

The Role of the Nuclear Regulatory Commission

The Nuclear Regulatory Commission (NRC) has a national responsibility to insure that commercial nuclear power plants are operated in a safe, secure, and effective manner. NR has a close working relationship with the NRC. The NRC does not formally license navy reactors, but today NR fully coordinates with NRC on the engineering details of its designs in a full, transparent, and collaborative nature.

Ultimately, were SMRs to be proven in operation for critical military facilities, they should subsequently be made available for broad commercial use. Having the US government initiate the production of SMRs for national security purposes would provide the opportunity to prove out SMR operational designs (we would want at least two different designs) and overcome the risks associated with first production. But

to commercialize SMRs, the NRC would of course be required to validate their safety and security before they could be operated by commercial power companies.

Establishing the Mandate

The mandate for moving ahead with SMRs would be relatively straightforward, though it would require a strong consensus. Congress would have to pass legislation that would:

- Establish a national goal for secure, reliable power support for critical national security installations
- Authorize the Department of Defense to undertake the mandate on behalf of the federal government
- Designate Naval Reactors to be the executive agent for the program
- Stipulate that the program must be grounded with commercial designers/operators who would be given long-term power purchase agreements
- Require that no SMR built under the auspices of this program could be commercialized without NRC review and approval

Conclusion

America must stay in a leadership role on commercial nuclear energy. Our national security directly depends on this. But America's commercial nuclear power industry is threatened because of inexpensive natural gas. Nuclear power will only be sustained through a federal government mandate. The government also needs a solution to the growing problem of cyber-vulnerability of the commercial power grid. SMRs offer a uniquely attractive solution to this problem.

The pathway is clear. We now need leadership in Congress to bring it to action.

About the Author

John J. Hamre is president and CEO of the Center for Strategic and International Studies (CSIS). He served as US deputy secretary of defense from 1997 to 1999 and undersecretary of defense (comptroller) from 1993 to 1997, where he aided in management of the defense budget. Before his tenure at the Department of Defense, Hamre was professional staff member to the Senate Armed Services Committee and deputy assistant director at the Congressional Budget Office. He received a doctorate from the School of Advanced International Studies, Johns Hopkins University.

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SHULTZ-STEPHENSON TASK FORCE ON

Energy Policy

The Hoover Institution's Shultz-Stephenson Task Force on Energy Policy addresses energy policy in the United States and its effects on our domestic and international political priorities, particularly our national security.

As a result of volatile and rising energy prices and increasing global concern about climate change, two related and compelling issues—threats to national security and adverse effects of energy usage on global climate—have emerged as key adjuncts to America's energy policy; the task force will explore these subjects in detail. The task force's goals are to gather comprehensive information on current scientific and technological developments, survey the contingent policy actions, and offer a range of prescriptive policies to address our varied energy challenges. The task force will focus on public policy at all levels, from individual to global. It will then recommend policy initiatives, large and small, that can be undertaken to the advantage of both private enterprises and governments acting individually and in concert.

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