NEAC International Subcommittee Report

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Nuclear Energy's Strategic Global Role

Nuclear energy, by its very nature, is of vital strategic importance. The tremendous power of the atom can be harnessed to bring civilizations into the modern age or destroy them utterly. With the expansion of nuclear energy around the globe, it is critical to the U.S. national interest that we ensure that the "Atoms for Peace" bargain is fully realized and that nations have access to safe and secure U.S. nuclear energy technologies. As noted by numerous national security experts, "One of our nation's most powerful tools for guaranteeing that the countries acquiring this technology continue to use it exclusively for peaceful purposes is to ensure that the U.S. commercial nuclear industry continues to play a leading role in the international civil nuclear marketplace." A nuclear power plant is an enduring asset that forges a century long relationship between the host country and the nation that supplies the reactor and later the fuel, major components, operations, maintenance, and security. This special relationship enables the supplier nation to influence other countries' energy security, nuclear safety, and a myriad of other policies and decisions. This situation is well recognized by U.S. competitors – most notably China and Russia. They are utilizing civil nuclear energy as part of their international engagement, especially with developing countries, to advance their broader global goals. This integrated approach is lacking in the United States and is detrimental to our national security objectives.

At this point in time, two-thirds of the commercial nuclear reactors under construction are of Chinese or Russian design. Russia is aggressively exporting its reactors and their associated technologies. China has embarked on a major development program and is on track to achieve the world's largest nuclear fleet within 20 years. The United States is also experiencing significant competition from other state-backed companies, including those from the Republic of Korea, France, and Japan. Russia is now actively marketing take-back of used fuel for contracts in which they provide the reactor and the new fuel – this gives Russia a unique and valuable advantage with which U.S. vendors cannot compete without a capability to take U.S.-supplied foreign used fuel back into the U.S. Furthermore, many of the state-backed companies provide attractive comprehensive financing packages, another attribute with which U.S. companies are currently unable to compete.

Most of the growth of electrical energy is in the developing world. The global population will grow from 7 billion people today to approximately 10 billion people in 2050 with a resultant increasing demand for electricity. Today, 20% of the world's population has little, or no, access to electricity. The greatest growth of nuclear energy is in China, India, the Republic of Korea, Russia, and soon the Middle East. The U.S. Department of Commerce estimates the global civil nuclear market to be valued between $500 and $740 billion over the next 10 years and to have the potential to generate more than $100 billion in U.S. exports and thousands of new jobs. This represents a major opportunity for job growth in the U.S. nuclear industry that is not being fully realized.

The United States must have a healthy domestic civil nuclear industry in order to compete internationally. Currently the domestic nuclear power fleet is declining and

being allowed to atrophy. By 2055, many of the approximately 100 currently operating U.S. reactors will be shut down and there are only four new reactors under construction. The USG needs to develop a new, creative arrangement with the private sector that supports the development of economically competitive power reactors and their associated technologies that can be deployed both in the U.S. and internationally.

To play a global leadership role in the 21st century and beyond, the United States must implement a dynamic and aggressive strategy, recognize and utilize our strengths in the civil nuclear arena, and be a leader in nuclear waste management, starting by getting the U.S. program back on track. The U.S. should make civil nuclear energy a foreign policy strategic imperative. Otherwise, the development of nuclear energy will be led by other countries to the detriment of U.S. national security, economic, and other strategic interests.

Executive Summary

The Nuclear Energy Advisory Committee's (NEAC's) International Subcommittee was given tasks that focused on: (1) enhancing U.S. industrial participation in the global nuclear energy market, (2) assuring a resurgence of U.S. leadership in advanced nuclear research, development and demonstration (RD&D), and (3) addressing current governmental policies and programs to reassert influence in international civil nuclear developments.

U.S. leadership in nuclear energy has diminished since the early days of the nuclear era when the United States was the unquestioned global nuclear leader. This historic leadership allowed the United States to have a healthy domestic nuclear energy enterprise, global business success, and policy influence over the utilization of civil nuclear energy from safety, security, nonproliferation, environmental, waste management, regulatory, and economic perspectives. The erosion of these competitive positions, and related policy influence, affects the health and size of the U.S. nuclear industry, the associated jobs and economic prosperity, leadership in cutting edge nuclear research, development and deployment (RD&D), and the trajectory of the international nuclear regime and, importantly, preventing the spread of nuclear weapons. A nuclear world without strong U.S. participation would be more dangerous and volatile and would undercut vital U.S. national security, environmental, and safety interests.

This report recommends actions that respond to the assigned tasks and offers opportunities for a resurgent and enhanced domestic and international nuclear future.

The major areas where the Department of Energy (DOE) and the United States Government (USG) can help project U.S. civil nuclear energy leadership in cooperation with commercial industry are:

- To make civil nuclear energy a foreign policy strategic imperative, with proper coordination across USG agencies, including coordinated USG advocacy for U.S. companies' civil nuclear exports because of their positive impact on domestic

jobs, the safety and security of the global civil nuclear enterprise, and the support of U.S. policy objectives;

- To support the continued safe and reliable operation of existing U.S. nuclear power plants and encourage the construction of new nuclear power plants by putting them on an equal footing relative to other power generation sources, thereby restoring the technical credibility, a robust supply chain, and leadership of the United States in the civil nuclear energy field;
- To simplify and streamline U.S. nuclear export regulations and processes to help facilitate the efforts of U.S. commercial companies trying to compete for international businesses;
- To make available export credit agencies', e.g., Export-Import Bank (ExIm Bank), financing to U.S. companies for major international nuclear projects, without which U.S. companies cannot compete with foreign state-backed companies. These countries would also benefit from a mechanism that guarantees the supply of fresh nuclear fuel;
- To help new nuclear entrant countries set up appropriate international nuclear liability regimes, e.g., Convention on Supplementary Compensation (CSC), that are acceptable to U.S. companies;
- To draw upon and integrate other strengths and capabilities of the United States in the nuclear field, most notably our national laboratories, research universities, and our academic and training capabilities; and
- To increase funding and the use of new approaches to public-private arrangements for RD&D for innovative nuclear technologies to help regain U.S. global leadership, including modernization of NRC processes for licensing of advanced nuclear systems.

The findings upon which these recommendations are based are discussed in more detail later in this report. In addition, recommendations are provided to improve the existing situation to the benefit of the U.S. civil nuclear industry and the USG.

Introduction

In the early days of civil nuclear energy, the United States was unquestionably the global leader in this new and promising technology. This position was bolstered by then President Dwight Eisenhower in his Atoms for Peace proposal and the Atomic Energy Commission that strongly promoted the peaceful uses of nuclear energy. This leading position was maintained for several decades until nuclear power fell into disfavor domestically in the 1970s following the 1972 Arab oil embargo and, more importantly, after the Three Mile Island Unit 2 (TMI-2) accident, and government-funded research and development (R&D) decreased dramatically after these events. In addition, the costs and schedules of new construction projects were escalating significantly over this period as the growth of electricity consumption slowed and new regulations were instituted as a result of the TMI-2 accident. This resulted in the cancellation and/or delay of a large number of new plant construction projects. As of today, 99 nuclear power reactors are

operating; supplying about 19% of the U.S. electricity demand, and four new reactors are under construction. Unfortunately, a number of nuclear plants are prematurely shutting down permanently, which will reduce nuclear energy's contribution to domestic electricity supply in the coming decades.

While this was happening in the United States, other countries such as France, Japan, and the Republic of Korea, that were not blessed with abundant domestic energy resources, strongly promoted the development and deployment of nuclear power for electricity production. By and large, their systems were based on U.S. technologies through the transfer of know-how from leading U.S. companies. With these national nuclear programs came the emergence of their own nuclear supply companies to challenge the U.S. leadership position. More recently, two additional supplier countries have emerged – Russia, the Republic of Korea, and soon to be China, to challenge the United States and these other foreign nuclear suppliers.

A snapshot today shows that nuclear power is generally moving forward on a global basis for a variety of reasons, including environmental quality, energy independence, and national security. Currently, there are approximately 60 nuclear reactors being constructed worldwide, with the majority of new construction taking place in Asia, while in the United States and parts of Europe nuclear capacity may contract. Some studies show that nuclear power must increase significantly over the coming decades to meet growing electricity demand, improve environmental quality, avoid increasing reliance on imported energy, and help combat climate change. Although projections often change and have recently been lowered (largely as a result of the Fukushima accident), most studies indicate that nuclear power expansion will continue in a number of countries, most aggressively in China, Russia, and India, but also in the United Kingdom, Saudi Arabia and the Republic of Korea.

What is new today is a broad-based interest in new technologies as a possible means of reversing the trend in increasing costs of new nuclear power plants and possibly deploying a more acceptable technology for the long-term future. The latest and most advanced technology being built today is advanced light water reactors (ALWRs), the so-called "Generation III+" technology that relies on passive safety systems to defend against potential reactor plant accidents, including severe external events such as occurred in Fukushima, Japan. The United States is the innovator of this technology, which has already been exported to China, is being built in the United States, and is awaiting favorable new opportunities internationally in the United Kingdom, Mexico, Saudi Arabia, and India, for additional near-term sales. Such open international opportunities do not occur that often and the USG should be planning proactive initiatives to support domestic companies. It should be emphasized that every $1 billion of export sales supports between 5,000 and 10,000 domestic U.S. jobs – jobs that can start well in advance of construction.

Furthermore, interest has been building globally in an emerging new technology – light water cooled Small Modular Reactors (SMRs) that also use passive safety technology, may incorporate the nuclear steam supply system into a single reactor vessel, and utilize

factory construction techniques. These features provide the opportunity for reducing equipment, commodities, and labor costs, and as well as shortening the construction schedule of these new plants. SMRs could play an important role in addressing the energy security, economic, and climate goals of the United States if they can be economically competitive and commercially deployed within the next decade. They might also be used in ways that simplify the modernization of the U.S. electricity grid. Moreover, there may be a significant global market for SMRs because their output may be appropriate for the small grids that exist in the developing world. The range of applications of SMRs also go beyond traditional electricity generation to include such things as desalination, and other types of hybrid energy systems which open the door to additional commercial opportunities. Many countries that have not established an indigenous SMR program have expressed an interest in SMRs, including the United Kingdom, Jordan, Saudi Arabia, Turkey, and Canada. A successful U.S. SMR program could re-establish the nation's technical leadership in nuclear energy via international sales and domestic deployment.

Most recently, there has been a resurgence in interest in advanced non-LWR technologies, including liquid metal reactors, molten salt reactors, and gas-cooled reactors. This interest is spurred by claims of better fuel utilization, higher thermal efficiencies, reduced water use, higher operating temperatures that can be used for non-electricity applications, and reduction of high level waste. These advanced reactor designs are being promoted by more than 20 new startup companies (plus a few established vendors) in the United States and many are being financed by venture capital. This level of private sector interest in advanced reactor technologies has never been seen before. It remains to be seen if those claims can be substantiated and if private funding is sufficient for completing design development, licensing, and commercial deployment.

Nuclear energy is both an environmental and a national security imperative. China and India are both examples where reducing atmospheric pollution has become a national goal. National security and environmental security are alternative sides of the same coin – and, as such, can be attractive to a range of audiences. From a national security perspective, there are indications once again of growing global reliance on imported oil and natural gas over the next thirty years, with resulting vulnerability to supply interruption. Although the United States is largely "energy independent", much of the world is not! Furthermore, global energy prices will have an impact on U.S. energy prices. All sources of supply — including nuclear, coal, solar, wind, and shale gas — produced outside the volatile Middle East energy sector add to diversity of supply and avoid dependence on any one source, which is important for economic security as well as national security.

Maintaining both a healthy domestic civil nuclear program and a successful nuclear export market support U.S. non-proliferation goals. These endeavors offer a significant degree of USG engagement with foreign countries through the various export control processes and regulations. They also demonstrate that the United States is committed to the safe deployment of the peaceful uses of nuclear energy, which has a significant positive impact on the global environment. Maintaining a healthy domestic program will

ensure that the companies involved will be available to provide long-term support for the emerging foreign civil nuclear programs, thus helping these nations maintain safe, economic, and reliable operations of their growing nuclear capacity, while also assuring that these foreign states do not become dependent on one specific nation for their energy and economic security.

The United States is currently at a cross roads with its domestic program. More reactors are retiring than are being built for a variety of reasons, but mostly related to an electricity market that does not properly value non-emitting base-load capacity. Given the potential impact of these retirements on the U.S. electricity supply and local economies, some states are attempting to address the problem, but it is not clear if this is enough. A relevant question is whether and to what extent the DOE, and more broadly, the USG should take steps to alter this trend? For example, perhaps the Congress and Federal Energy Regulatory Commission could enact laws and establish regulations to put all power generation sources that supply clean, reliable electricity on a 24/7 basis on an equal playing field with those intermittent sources that currently receive preferential treatment. This could help prevent premature shutdowns of currently operating nuclear power plants.

A vibrant U.S. nuclear energy RD&D program based on current as well as advanced nuclear technologies is important to the global growth of nuclear energy, and could ensure that the United States will remain engaged in this effort and help influence its direction. A nuclear world without strong U.S. participation would be more dangerous and volatile, and would undercut vital U.S. national security, environmental, and safety interests. Highly creative U.S. national laboratories, an independent nuclear regulatory agency, world class research and teaching universities, the highest respect for non-proliferation, and an experienced and competitive industry are all elements of the U.S. contribution to the peaceful uses of nuclear energy in the future; this capacity not only benefits the United States, but all nations.

The USG should therefore ensure that the United States retains strong programs, and a global leadership role in nuclear science and engineering at our universities and our national laboratories, since these programs are essential in support efforts addressing national security, nonproliferation, nuclear regulations, health physics, nuclear safety, nuclear waste disposal and environmental cleanup programs. Capabilities to test nuclear fuel and materials are essential elements in these efforts, and are also used to support the domestic nuclear industry. Consequently, the USG should ensure that there are vibrant RD&D programs, including adequate test reactor facilities, to serve these needs. To the extent that domestic facilities can be supplemented with international facilities to support development of advanced nuclear systems and fuels, such options should be examined to promote the most efficient utilization of global nuclear research assets.

It should be noted that the tasks addressed by the NEAC International Subcommittee are very broad and encompass both technical and policy issues. As such, some of the recommendations reach beyond the charter of DOE's Office of Nuclear Energy (DOE/NE). In fact, some go beyond the entirety of the DOE, requiring actions across

different USG agencies. It is envisioned that for such recommendations, the DOE/NE will act as the catalyst to bring these diverse agencies together as part of the interagency coordination effort to take effective actions for the benefit of the nation and its civil nuclear energy industry.

Subcommittee Charge

The Nuclear Energy Advisory Committee (NEAC) was asked by DOE to direct the International Subcommittee to undertake two tasks as stated in a NEAC charge letter dated June 16, 2016, and provided in Appendix A. The International Subcommittee met on three separate occasions with DOE national laboratories, nuclear industry organizations and private sector companies to discuss topics related to Tasks 1 and 2 as listed in Appendix D.

Task 1 – Examine and provide recommendations on how the Office of Nuclear Energy could further support the USG international commercial nuclear energy policies and priorities.

Requested Approach from DOE – Engage with industry's trade and advisory groups, and individual firms that provide, or are planning to provide, products and services to the global nuclear market.

Discussion

The DOE and USG are currently involved in many activities that relate to international civil nuclear policies, advocacy, trade, safety, and security. A brief discussion of these activities is provided in Appendix B. Further, the NEAC International Subcommittee had previously been given two charges from DOE that directly relate to this current task:

- Review the full scope of NE-6 international activities in order to evaluate the most effective method to support U.S. nuclear exports and overall international nuclear commercial leadership as part of a "Team USA approach" (February 2012); and
- Review the existing nuclear collaborations between the U.S. and China, and make recommendations as to potential approaches and mechanisms to increase the effectiveness of this collaboration to support U.S. Government objectives and initiatives (February 2015).

The resulting recommendations from this past effort by the International Subcommittee are provided in Appendix C.

Task 2 – Identify international nuclear facilities that the U.S. nuclear industry could leverage to support the further development of the Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative and complement existing U.S. facilities.

Requested Approach from DOE – Review past efforts by the national laboratories to identify and catalog the international nuclear facilities and their major capabilities with the objective of analyzing gaps and what is needed to leverage the GAIN Initiative.

Discussion

The Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative is an administration initiative started in November 2015 as an organizing principle to facilitate timely achievement of three DOE strategic goals:

- Maintaining global technology leadership,
- Enabling global industrial leadership, and
- Assisting in the optimized use of nuclear energy domestically within the clean energy portfolio.

The GAIN Initiative headquartered at the Idaho National Laboratory (INL) is based on three premises:

- National and global demand for nuclear energy is increasing and U.S. global leadership is eroding,
- There is a sense of urgency with respect to the deployment of the innovative nuclear energy technologies, and
- An effective private-public partnership is required to achieve the above strategic goals.

The achievement of GAIN's strategic goals can bridge the gap between technology leadership and industrial leadership and, combined with optimized domestic deployment, will enable rapid, cost-effective development of innovative nuclear energy technologies towards market readiness. The GAIN model for new technology development moves away from a sequential progression for innovation to a more integrated process that achieves the strategic goals simultaneously, resulting in a faster more cost-effective innovation cycle.

The GAIN Initiative will provide nuclear innovators and investors with a single point of easy access to a broad range of capabilities (people, facilities, materials, and data bases) across the DOE complex. It will provide focused research opportunities and dedicated industry engagement, ensuring that DOE-sponsored activities are impactful to a broader base of stakeholders. Furthermore, it will expand upon DOE's work with the NRC to assist technology developers through the complex regulatory process, particularly the non-LWR regulations and guidance where there is relatively little experience.

In the year since its creation, GAIN has established an organization within the DOE laboratory complex, issued an execution plan, held technology-specific workshops, and implemented a standardized voucher program that helps fund access to the extensive nuclear research capabilities available at DOE's national laboratories and Nuclear Science

User Facilities (NSUF) partners. In 2016, DOE awarded eight NE vouchers to small businesses worth a total of approximately $2 million to help them accelerate development of innovative nuclear technologies.

The NSUF is a consortium formed to undertake an enterprise beyond the resources of any one member. DOE/NE, with the Idaho National Laboratory (INL) as the lead institution, established the NSUF in 2007. It currently has 13 members -- eight universities, four national laboratories, and one industrial partner. It is designed to conduct rapid turnaround experiments (typically fuels and materials) for projects selected from submitted proposals through open competition.

General NSUF capabilities include neutron reactor irradiations, ion irradiations, hot cells, high radiation level measurements, low radiation level measurements, and various beamlines. The NSUF efforts can provide rapid and cost-effective advancement of scientific foundations while retiring technical and licensing risk for innovative technologies.

DOE has established a selection process for R&D projects with several stages of application through award. International applicants need a U.S. collaborator to be considered. Over the past four fiscal years there has been a steadily increasing number of applications and down-selections at each stage in the process. Awards with international collaboration have also increased from three in FY2014 to 13 awards in FY2017. Typical awards can range from $0.5 million to $4.0 million and last up to 7 years, depending on the scope of the projects. There are currently several international collaborations under NSUF:

- Belgium – Belgian Nuclear Research Center (SCK-CEN)/Belgium Reactor 2 (BR2)/Laboratory for High and Medium Activity (LHMA);
- United Kingdom – National Nuclear Laboratory (NNL)/University of Manchester;
- Norway – Halden Reactor/Institute for Energy Technology (IFE); and
- Others in the works include Sweden – Studsvik; Germany – Thermal Hydraulic Test Loop (KATHY) in Karlstein; European Commission – Joint Research Center; and Japan – JOYO sodium-cooled fast reactor.

The NSUF can support the GAIN Initiative by maintaining a current database of both the domestic and international nuclear infrastructure facilities that could be utilized to help support nuclear innovation. This database was started in 2014 at the direction of DOE/NE. The database, known as the Nuclear Energy Infrastructure Database (NEID), is searchable and interactive, and had its public launch in November 2015.

Currently, about 80% of the NEID entries are for U.S. domestic infrastructure and capabilities. NEID houses information on more than 125 domestic institutions, operating over 450 facilities, which include over 960 instruments. NEID users include researchers from 75 federal government and national laboratories, 38 universities and NGOs, and 25

industrial organizations. Among the data included in the NEID database are test and research reactors, hot cells, ion beams, support infrastructure (shipping casks, test fabrication, etc.), and state-of-the-art instrumentation and expertise.

Approximately 20% of the entries in NEID are for international infrastructure and capabilities. These are mostly institutions with some of their associated facilities. Test reactors and some hot cell facilities are included, but there is little information on instrumentation capabilities. Much more work is needed to broaden the international portion of the database. Collaborations like those involved in the NSUF will help fill out the database and additional collaborations will be very useful.

The NSUF can be further internationalized through continued collection and inclusion of data on international nuclear infrastructure and capabilities via the NEID. This will be significantly enhanced as additional collaborations like those listed above are made and better understanding of these facilities is obtained. An important part of making effective use of these international facilities is to perform a gap analysis between domestic nuclear infrastructure capabilities and international facilities. That could indicate where current U.S. capabilities cannot meet the needs of potential users, particularly those interested in advanced innovative technologies. Also, in 2017 the DOE Nuclear Energy University Program (NEUP) will begin collaboration with the OECD-Nuclear Energy Agency's Nuclear Energy Skills and Technology framework to further promote international partnering in research projects and the development of human resource capacity. (Note that NEUP funds only support the U.S. partner in any collaboration.)

General Findings

Several common themes emerged from the discussions with companies trying to do business outside of the United States. The first theme is the difficulty of U.S. companies to obtain adequate financing for major international projects in order to compete with suppliers from countries that have state funds readily available. Financing is almost always a major issue in international contracts, particularly for developing countries that cannot self-fund large infrastructure projects. Our ExIm Bank is important to our competitive position. Currently, the ExIm Bank is not fully functional, with a limit of $10 million loans. Nuclear power plants are multi-billion dollar projects that require multi-decadal contracts, which the private sector is unwilling or unable to support. Russia and China are both able to provide significant state-backed financing to win contracts in countries unable to finance nuclear power plants themselves, repeatedly outcompeting U.S. bids on these same projects.

Russian contracts, including build, own, and operate arrangements for new plants, are also often bundled with financial assistance in human resource development, national nuclear regulatory development, and, most importantly, a used fuel take-back program. Fuel take-back is the process whereby the fuel supplier takes back the used fuel after discharged from the reactor and disposes of it somewhere other than in the user nation. U.S. supply companies are not permitted by law to take back fuel that has been exported

and used abroad, and thus, cannot compete in this arena in the global market without legislative changes coupled to a viable U.S. waste program.

The second theme concerns U.S. nuclear export regulations that are generally complex, restrictive, and time consuming to navigate and fulfill, particularly for a country new to U.S. nuclear energy programs. Whereas most international export control regimes provide a single export licensing agency to handle exports of nuclear equipment and technology, U.S. authority is divided among the Departments of Energy, State and Commerce, as well as the Nuclear Regulatory Commission (NRC); this results in four very different sets of regulations coupled with a complex interagency review process. Compared to other countries, the U.S. export control processes imposes few deadlines for decision making on export license applications, often resulting in waiting periods of one to two years. The length of time required can have significant commercial consequences. This gives our competitors an advantage in that they can move much more rapidly than U.S. companies.

The major export control agreements are:

- 123 Agreements for Peaceful Cooperation – Section 123 of the U.S. Atomic Energy Act requires the conclusion of a country specific agreement for significant transfer of nuclear material, equipment, or components from the U.S. Section 123 Agreements are important tools in advancing U.S. nonproliferation goals. The agreements also allow for cooperation in other areas such as technical exchanges, scientific research and safeguards discussions. The United States has Section 123 Agreements in place with 22 countries, EURATOM, the IAEA, and Taiwan. Many countries that are developing new nuclear programs do not have Section 123 Agreements, which closes the market to U.S. reactor sales and sales of major nuclear components.
- 810 Authorizations – Part 810 of Title 10, Code of Federal Regulations implements paragraph 57.b (2) of the Atomic Energy Act for authorizing the transfer of unclassified nuclear technology and assistance to foreign countries on the peaceful uses of nuclear energy. DOE grants these 810 authorizations, with the concurrence of the Department of State (DOS) and after consulting with the Departments of Defense and Commerce and the NRC. These authorizations apply to technology transfers and assistance related to nuclear fuel cycle activities, commercial nuclear power plants, and research and test reactors. The need for country-specific 810 authorizations, and in some cases inconsistent treatment of countries, e.g., Norway, Mexico, Ukraine, and Chile, add to the burden of companies trying to undertake civil nuclear business overseas.
- 110 Agreements – Part 110 of Title 10, Code of Federal Regulations establishes licensing requirements for any person that seeks to import or export NRC-controlled nuclear equipment or material, including power reactors and their especially designed components.

Some serious streamlining of the export control process is in order and is particularly important for smaller companies moving into the international civil nuclear area. Recommendations to accomplish this streamlining are given later in this report.

A third theme is the U.S. implementation process of the Convention on Supplementary Compensation (CSC), which is an international nuclear liability treaty negotiated under the auspices of the International Atomic Energy Agency (IAEA) and adopted at a Diplomatic Conference in Vienna in 1997. The United States proposed the CSC and has actively promoted the CSC since its adoption. The CSC was developed to (1) provide a basis for global nuclear liability regime that includes all countries that might be affected by a nuclear incident, and (2) to increase the amount of funds available to compensate for damage resulting from any nuclear incident. The CSC came into effect in April 2015 and currently has eight members -- Argentina, Ghana, India, Japan, Montenegro, Romania, United Arab Emirates and United States. The U.S. nuclear suppliers generally support the CSC since it provides them protection against potentially unlimited liability resulting from their participation in nuclear projects outside the United States. However, CSC implementing legislation requires U.S. nuclear suppliers to reimburse the U.S. government if the USG is required to make a contribution to the CSC international fund in the event of a nuclear accident outside the United States. U.S. nuclear suppliers reluctantly accepted this potential cost as the price for the "insurance" provided by the CSC. Some suppliers have suggested that Congress should reconsider this requirement that U.S. nuclear suppliers reimburse the USG.

Finally, in 2010, the Civil Nuclear Trade Advisory Committee (CINTAC) in the Department of Commerce recommended the establishment of a White House level coordinator for international nuclear energy policy. Several other nuclear industry groups supported this initiative as well. In response, a position was established in the Executive Office of the President to coordinate government activities relating to international civil nuclear energy and technology initiatives. This new role was designated as the Director for Nuclear Energy Policy in the National Security Council (NSC). Responsibilities included coordination of USG policy and activities in the areas of: (1) international nuclear safety; (2) international nuclear liability, fuel cycle and waste management issues; (3) capacity building; (4) civil nuclear cooperation agreements; (5) nuclear research and development, and (6) outreach to the U.S. nuclear industry, including the coordination of advocacy overseas. The Director handled additional roles as well. These included convening the USG interagency working group on international civil nuclear activities, coordinating Team USA efforts across government agencies, and serving as a point of contact for industry on questions and issues related to international initiatives. The Director also participated in the annual meeting in Vienna, Austria, in conjunction with the IAEA General Conference between the U.S. industry delegation and the Secretary of Energy, the Chairman of the NRC and other government officials. The dialogue with the Director was very productive and was seen by the private sector as one of its most valuable interactions with the government. However, in 2016, during a period of downsizing, the NSC Director for Nuclear Energy Policy position was eliminated. Team USA is now coordinated by DOE and replaces much of the Director's former role,

but unlike the Director, cannot provide the same level of White House support and coordination on USG nuclear initiatives and collaboration with the nuclear industry.

Task 1 Specific Findings

- Civil nuclear energy should be a foreign policy strategic imperative. As such, it needs a U.S. government agency coordinating strategy. In this regard, the NSC staff position at the White House is an important element for effective international strategic engagement. Also, there is a need for closer cooperation between DOE civil nuclear efforts and NNSA non-proliferation activities in emerging markets.
- U.S. nuclear market leadership is at a "tipping point" with respect to its influence in nuclear matters internationally; the USG needs to help restore the U.S. position.
    - It is extremely important to have a robust domestic U.S. nuclear energy industry to have a viable market for export. The U.S. nuclear industry needs to demonstrate success at the Vogtle and V.C. Summer nuclear power plants, despite early delays and increased costs, and viable new nuclear projects need USG support. Continued incentives such as those implemented in the Nuclear Energy Policy Act of 2005 could help with additional projects and demonstrate to the world that the USG supports the expansion of safe and reliable nuclear energy.
    - The United States is the innovator of, and leads the world in, the development of SMRs. Continued and expanded support for the U.S.-initiated SMR program is important to ensure domestic vendors maintain their leadership position globally in this technology.
- There is a need for the U.S. government, including Congress, to better understand the size of the global nuclear market, and therefore the potential job creation through international nuclear sales. This would show that the United States is "open for business" through strong USG support, because currently U.S. companies are competing against state-backed companies.
- The nuclear market is blurred internationally, particularly with joint efforts between major U.S. companies and those in the Republic of Korea, Japan, and China. In some cases, U.S. companies are cooperating with companies from these nations and in other cases they are competing against them.
- ExIm Bank financing is very important, even if not explicitly used on a particular project. The United States also needs to develop other financing options for nuclear, e.g., utilizing the Overseas Private Investment Corporation (OPIC). Some potential lenders, e.g., the World Bank, preclude loans for nuclear projects. The USG should encourage broader financing options be available for nuclear exports.
- Additional funding for DOE and NRC is important to help train engineering and management personnel from emerging markets to develop appropriate standards and gain familiarity with the U.S. nuclear research and regulatory system.

- There is a need for clear U.S. government nuclear energy policy for both LWR programs (including near-term Small Modular Reactor (SMR) programs), and advanced nuclear programs so that all agencies speak with the same voice. This is important so as not to instill uncertainty in potential foreign collaborating agencies/companies. Countries that do not have well-established civil nuclear power programs want to know on which path U.S. RD&D is moving so that they can rely on it for long-term assistance.
- Many countries want U.S. involvement even if the major contract is with companies from other nations. This provides a degree of confidence that their projects will be of the highest quality and meet international standards.
- There is a need to "refresh/revise" some U.S. civil nuclear bi-lateral agreements and complete new ones (e.g., Mexico and Saudi Arabia) to facilitate cooperation between the United States and countries that are likely to start significant nuclear power programs.
- The various U.S. nuclear technology export control authorization processes are complicated compared to those of other countries, and they can take long times to approve, e.g., 18 months and longer, even for friendly countries, in some instances because there may be a slow response to requests for information to complete the process. In particular, the authorization process needs to be tailored for smaller developing countries and assistance provided to fill out the applications.
- The 123 Agreement process needs to be more transparent and implemented without bias to all eligible countries so that the U.S. is viewed as even-handed in its dealings with emerging market nuclear countries.

Task 1 Recommendations

- Present to the new administration projections for international nuclear export opportunities, the size of the projects and market, and the potential number of resulting U.S. jobs. Further, emphasize that a strong domestic nuclear industry is a prerequisite for U.S. companies to be credible in international markets. This should include actions to retain our currently operating fleet of reactors, and incentives to promote the construction of new advanced LWRs, including SMRs.
- In cooperation with the U.S. nuclear industry, work with Congress to obtain full authorization of the ExIm Bank. A full Board of Directors must be appointed so that an appropriate level of financing can be available to U.S. nuclear export companies. Convene a civil nuclear energy workshop to develop ideas with the ExIm Bank and other potential export credit funding agencies (e.g., U.S. Trade and Development Agency and the Overseas Private Investment Corporation) to ensure availability of export credit financing and to expand financing vehicles available to U.S. companies in the civil nuclear area.
- Work with Congress to modify the Nuclear Waste Policy Act to aggressively move forward with a Consolidated Interim Storage Facility and, in parallel, assure

that the geological repository program for used nuclear fuel is on a path toward operation. At the same time, provide provision for a fraction of the capacity of each repository and interim storage facility to be available to accept U.S.-supplied fuel for take-back from other countries. There is a precedent for this in the take back of U.S.-supplied foreign research reactor fuel.

- Develop an action plan to support civil nuclear exports – Key actions could include:
    - Establish a position in the White House for nuclear energy policy, but unlike in the past, it should be at the level of a Senior Director in the National Security Council staff to assure that these issues receive the attention and action that are needed to advance U.S. strategic interests.
    - Prepare for the next international sales opportunities by pulling together all relevant agencies, in cooperation with private companies, to determine proactive initiatives that can help obtain a United States win – the U.S. government should view itself as a partner with the U.S. industry in these activities.
    - Consider other recommendations that CINTAC has recently written in a letter to the Department of Commerce to promote U.S. nuclear industry, enhance its competitiveness, and eliminate the barriers to international nuclear trade. (See February 28, 2017, CINTAC letter to Secretary Ross, (http://www.trade.gov/mas/ian/nuclear/tg_ian_003233.asp)
- Convene a workshop with DOE, CINTAC, nuclear supplier, etc., to look for ways of streamlining the nuclear export authorization process while maintaining the intent of the current regulations. Activities could include:
    - Improve the efficiency, predictability, transparency, and speed of DOE's 810 export control licensing process. It is suggested that DOE take a proactive role in providing assistance to recipient countries in understanding and providing the information that is requested.
    - Conclude and/or renew agreements for peaceful nuclear cooperation under Section 123 of the Atomic Energy Act on a timely basis, particularly with key potential new market countries.
- The USG should continue to actively promote the Convention on Supplementary Compensation (CSC) to create a level playing field for U.S. companies, especially with respect to countries where nuclear projects may be undertaken in the near future. The current approach of requiring U.S. companies to contribute to the compensation fund should be rethought. Work with the likely U.S. suppliers to determine what revisions to the CSC process should be considered.
- The nuclear liability regime in India falls short of what is acceptable to U.S. suppliers because of the potential for very large judgments in the event of a reactor accident through no fault of their own; as a result most U.S. companies are not willing to engage in this potentially significant nuclear export market. The

USG should continue to recommend to India that it bring its liability system into line with international standards.

- Increase the DOE budget for training personnel from new markets early in their preparation stage and develop appropriate curricula. Examples of potential training are:
    - The Civil Nuclear Energy 101 program developed by DOE might be a good start as a broad-based introduction. It would also be good to provide the Civil Nuclear Energy 101 to U.S. university nuclear engineering programs in order to better provide nuclear engineering graduates with an understanding of the U.S. Government's engagement with other countries on civil nuclear energy.
    - The DOE could sponsor safety standards workshops (with NRC participation) for key emerging market government and industry personnel.
    - The DOE could sponsor ASME and other types of codes and standards workshops for key emerging market government and industry personnel.

Task 2 Specific Findings

- There are a large number of international nuclear facilities available that can complement existing U.S. facilities to fill gaps in U.S. R&D capabilities.
- Some of the potential nuclear facilities that could be used to leverage the GAIN Initiative are located in countries where changing political environments may make collaboration difficult and therefore should not be considered reliable partners.
- It can be difficult to transport internationally irradiated materials and, in particular, Special Nuclear Material.
- The U.S. nuclear enterprise already has a facilities database (the Nuclear Energy Infrastructure Database (NEID) through the NSUF program where both U.S. and international facilities are catalogued and their capabilities are shown; this is a natural starting point for U.S. companies who wish to utilize government facilities to advance their new technologies to determine the best partners.
- Processes and protocols exist for international collaboration. Different specific vehicles are typically implemented for each project, e.g., government-to-government agreements, CRADAs, Action Plans, etc.

Task 2 Recommendations

- To properly leverage the GAIN Initiative, a gap analysis between domestic nuclear infrastructure capabilities and international facilities should be performed to enable effective use of these international facilities by U.S. companies looking to develop their advanced technologies.

- Establish and/or simplify processes to facilitate U.S. companies that wish to collaborate with international nuclear facilities; a standardized process would greatly enhance the potential for such collaboration.
- Increase the funding and scope of the GAIN Initiative dramatically so that it can achieve its strategic goals. Further, a focus should be given on what GAIN funds to achieve a more rapid deployment of technologies that meet U.S. nuclear objectives.
- Examine the impediments to transporting small quantities of irradiated materials between countries for R&D. Establish processes to remove or significantly reduce these impediments.
- Develop typical timelines for different types of collaboration, e.g., special nuclear materials, irradiated materials, non-irradiated materials, etc., so that potential U.S. companies would have an appreciation for the length of time required for such international collaborations.
- The Generation IV International Forum (GIF) has started an initiative to have member countries self-identify facilities that would welcome international collaboration. The USG should take a proactive position to make the NEID the repository for international nuclear facilities utilizing this self-identifying process. The NSUF staff would need to verify the information inserted into the database. This could be accomplished in collaboration with IAEA to upgrade and maintain both databases.
- The NEID should be updated on a regular basis. Also, it would be desirable to track who is using the database and ask users how they would recommend improving the database, including providing assessments of the outcome from the collaborations.

Appendices

Appendix A – Charge Letter to NEAC International Subcommittee

Department of Energy
Washington, DC 20585

June 16, 2016

Dr. Richard A. Meserve
Covington & Burling LLP
850 Tenth St, NW
Washington, DC 20001-4956

Dr. Joy Rempe
360 Stillwater
Idaho Falls, ID 83404

Dear Dr. Meserve and Dr. Rempe:

I request that the Nuclear Energy Advisory Committee (NEAC) take appropriate action to direct its International Subcommittee to undertake the following tasks: 1) examine and provide recommendations on how the Office of Nuclear Energy could further support U.S. Government international commercial nuclear energy policies and priorities; and 2) identify international nuclear facilities that the U.S. nuclear industry could leverage to support the further development of the GAIN Initiative and complement existing U.S. facilities.

For Task 1, the Subcommittee should engage with the industry's trade and advisory groups (i.e., Nuclear Energy Institute and the Department of Commerce's Civil Nuclear Energy Trade Advisory Committee) and with individual firms that provide (or are planning to provide) products and services to the global nuclear market.

For Task 2, the Subcommittee should review past efforts by the national laboratories to identify and catalog the international nuclear facilities and their major capabilities with the objective of analyzing gaps and what is needed to leverage the GAIN Initiative.

The results of the reviews for Tasks 1 and 2 should be documented in reports to me before the end of the year.

I appreciate Dr. Regis Matzie's leadership and the subcommittee members' enthusiasm to undertake this important activity, and I and my senior staff look forward to a productive discussion of the results.

If you need any additional information, please contact me or Michelle Scott, the designated point of contact for the subcommittee, at (202) 586-9719.

Sincerely,

John F. Kotek
Acting Assistant Secretary
for Nuclear Energy

Cc: Dr. Regis Matzie
Chair, NEAC International Subcommittee

Edward McGinnis
Deputy Assistant Secretary for
International Nuclear Energy Policy and Cooperation

Michelle Scott
Senior Advisor
Office of International Nuclear Energy Policy and Cooperation

Appendix B – Current Activities by U.S. Government & DOE

The USG has a coordinated interagency approach towards nuclear energy activities. DOE/NE leads the Team USA meeting twice per month with DOE Environmental Management (DOE/EM), DOC, DOE/NNSA, the Exlm Bank, the State Department, and the NRC to discuss interagency nuclear issues and ensure a unified Team USA response.

U.S. Government Advocacy & Trade Missions

DOC leads USG advocacy efforts in coordination with all of the interagency. DOC generally advocates for all U.S. industry, but companies can apply for specific advocacy when circumstances apply. This is particularly important in the nuclear industry, where companies from other countries have strong backing from their national governments. It is essential, often as a matter of protocol, for the USG to advocate enthusiastically on behalf of U.S. companies on nuclear power plant bids.

Trade missions are another means through which the USG and industry works together to further U.S. commercial opportunities abroad. Trade missions involve a coordinated mission within a country where it is determined that strong commercial opportunities exist at a given time. Trade missions are planned with the support of U.S. Embassy representatives on the ground.

National Nuclear Security Administration

The National Nuclear Security Administration (NNSA) is a semi-autonomous agency within DOE. NNSA is responsible for enhancing national security through the military application of nuclear science. NNSA maintains and enhances the safety, security, and effectiveness of the U.S. nuclear weapons stockpile without nuclear explosive testing; works to reduce the global danger from weapons of mass destruction; provides the U.S. Navy with safe and effective nuclear propulsion; and responds to nuclear and radiological emergencies in the United States and abroad.

- **Nonproliferation**: One of the gravest threats the United States and the international community face is the possibility that terrorists or rogue nations will acquire nuclear weapons or other weapons of mass destruction (WMD). Through its Office of Defense Nuclear Nonproliferation (DNN), NNSA works closely with a wide range of international partners, key U.S. federal agencies, the U.S. national laboratories, and the private sector to secure, safeguard, and/or dispose of dangerous nuclear and radiological material, and detect and control the proliferation of related WMD technology and expertise. NNSA leads the USG in taking responsibility for its nonproliferation objectives and enhancing national security through the military application of nuclear science, but these objectives often overlap with the civil nuclear arena. In particular, the NNSA Office of Nonproliferation and Arms Control has exclusive control over issuing general and specific authorizations for the export of U.S. nuclear technology under the Code of Federal Regulations Part 810. Outcomes of the 810 authorization process have major implications for the U.S. civil nuclear industry.

- **Safeguards**: The Next Generation Safeguards Initiative (NGSI) has long been a champion of international Safeguards by Design (SBD). The purpose of SBD is to encourage nuclear plant designers and reactor vendors to consider safeguards early during the development process of a new nuclear facility to avoid the expense and inefficiency of retrofitting facilities to incorporate features necessary for a given safeguards approach. The NGSI assists in the ongoing IAEA SBD guide development. Finally, the NGSI continues to actively promote the SBD concept through direct engagement with industry partners, especially U.S. small and modular reactor design vendors. NNSA collaborates with more than 25 countries at all stages of nuclear development to strengthen the implementation of international safeguards. NNSA provides technical consultation, tools, and training to support the development of safeguards infrastructure in countries pursuing nuclear power.

Federal Loan Guarantees

Federal loan guarantees underpin new reactor construction in the United States. Under the authorization of the Energy Policy Act of 2005, DOE announced a $6.5 billion loan guarantee for construction of two AP1000 reactors at the Vogtle Plant in Georgia on February 20, 2014. The reactors are expected to come online in 2019 and 2020, respectively. DOE further announced a $12.5 billion solicitation for loan guarantees for Advanced Nuclear Energy Projects in December 2014, focusing on advanced reactors, SMRs, uprates and upgrades at existing facilities, and front-end nuclear projects. As of November 2015, DOE supplemented that solicitation to support costs incurred as part of the NRC licensing process, including those related to design certification, construction permits, and combined construction and operating licenses (COLs).

DOE Office of Nuclear Energy

In addition to leading Team USA, DOE's Office of Nuclear Energy (NE) coordinates a vast array of civil nuclear programs & initiatives, which include:

- **Light Water Reactor Sustainability (LWRS):** Develops the fundamental scientific basis to enable continued long-term safe operation of existing LWRs beyond their original operating licenses. The program works with the NRC to perform materials research that will aid the NRC in its deliberations for second license extensions.
- **Consortium for Advanced Simulation of Light Water Reactors (CASL):** Develops tools that enhance the current safety and enable power production increases and license extension. CASL is developing a "virtual reactor" to simulate reactor operations to improve both the safety and economics. The first five-year mission of CASL was to develop the "virtual reactor" only for analyzing pressurized water reactors (PWRs), but in its second five-year term, the program is extending its capabilities to include analyses of boiling water reactors (BWRs) and SMRs.
- **Small Modular Reactors (SMRs):** DOE's six-year, $452 million SMR Program was started in 2012 to provide financial assistance to technologies with high likelihood of domestic deployment by the mid-2020's.

- DOE opened up public-private partnerships with at least 50% cost share provided by U.S. industry partners. Two companies were selected during two separate procurement cycles. One industry partner, NuScale, completed the Design Certification application for its SMR and submitted it to the NRC in January 2017.
- DOE has a 3-year Cooperative Agreement with NuScale and the utility Utah Associated Municipal Power Systems (UAMPS) to conduct site characterization activities and to prepare documentation, such as the Final Safety Analysis Report, the Environmental Report, and the Security Plan. This will eventually lead to a Combined Operation License Application (COLA) for 12 NuScale SMR modules sited at the Idaho National Laboratory (INL).
- DOE has a 5-year agreement with the Tennessee Valley Authority to support first an Early Site Permit (ESP) and later a COLA. In May 2016, TVA became the first company to submit an SMR ESP to the NRC, which will assess the potential for construction and operation of SMRs at its Clinch River Site. Approval of the ESP is expected by mid-2019, and will be followed by submission of the COLA.

- **Advanced Reactors:** DOE does not focus on a particular technology, but rather, advocates broadly for optionality. Advanced reactor research consists of the following areas of interest: fast reactor technologies, high temperature reactor technologies, molten salt reactor technologies, advanced reactor generic technologies, advanced reactor regulator framework, and advanced reactor system studies. Additionally, the Supercritical Transformational Electric Power (STEP) initiative is exploring commercialization of supercritical carbon dioxide using the Brayton cycle energy conversion system.
- **Advanced Fuels:** Includes research in accident tolerant LWR fuel technology that could be used in the existing reactor fleet, as well as fuels for advanced reactors, e.g., particle fuels for gas-cooled reactors.
- **Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative:** Intends to provide the nuclear community with access to the technical, regulatory, and financial support necessary to move innovative nuclear energy technologies toward commercialization while, at the same time, ensuring the continued safe, reliable, and economic operation of the existing nuclear fleet. Further discussion of GAIN is included under Task 2 of this report.
- **Waste Management:** The FY17 budget includes funding for scientific research and technology development to enable storage, transportation, and disposal of used nuclear fuel (UNF) and high-level radioactive waste (HLW) generated by existing and future fuel cycles, and funding dedicated to evaluating shutdown sites, transportation planning and rail car development, and the generic design of a pilot consolidated interim storage facility.
- **Consent-Based Siting (CBS) Initiative:** DOE/NE held 10 public meetings in 2016 to initiate the process for consent-based siting of a consolidated interim storage facility and permanent geologic repository for UNF and HLW.
- **Nuclear Energy Advanced Modeling and Simulation (NEAMS):** Key focus areas include (1) to enhance the value of the NE R&D portfolio through integration of

advanced computational methods to accelerate meeting NE Roadmap objectives, and to help enable the next generation of nuclear technologies; and (2) to deploy advanced modeling and simulation tools to industry and academia for use by scientists and engineers in research, design, and analysis of nuclear power systems.

- **National Scientific User Facilities (NSUF):** A key contributor to the GAIN Initiative that aims to merge the national nuclear research infrastructure with intellectual capital to pair the best ideas with needed capability. NSUF provides no-cost access to the nuclear research capabilities and expertise through a consortium of partner facilities that the nuclear community (industry, small businesses, academia, and national laboratories) needs to maintain the operation of the existing nuclear fleet and the future development and deployment of advanced nuclear energy technologies.
- **Nuclear Energy University Programs (NEUP):** NE designates up to 20 percent of the funds appropriated to its research programs to university R&D, university infrastructure improvements, and human capital development (graduate-level student fellowships and undergraduate-level student scholarship grants) awarded through an open competition process to support nuclear science and engineering education. Furthermore, NE supports continued operation of U.S. university reactors by providing fuel services. Finally, NE awards grants to selected universities to train graduate level students in specific disciplines aligned with DOE workforce needs. The NEUP program, while awarding its funds only within the United States, coordinates with international funding sources to include non-domestic universities in selected research programs through utilization of funds from other nations.
- **International Nuclear Policy and Energy Cooperation:** International cooperation allows DOE to effectively leverage resources and partnerships in pursuit of its mission and broader USG priorities. Technical and policy support is provided for bilateral action plans, civil nuclear energy working groups and bilateral Memoranda of Understanding (MOU). Additionally, the International Cooperation office supports and provides coordination for NE's engagement in multilateral organizations such the International Atomic Energy Agency (IAEA), Generation IV International Forum (GIF), the International Framework for Nuclear Energy Cooperation (IFNEC), and the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD). Country Desk Officers act as liaisons with other countries and U.S. industry for interagency civil nuclear initiatives.

Appendix C – Previous International Subcommittee Recommendations Related to Task 1

In February 2012, the NEAC International Subcommittee was asked to review the full scope of NE-6 international activities to evaluate among other things, "how to most effectively support U.S. nuclear exports and overall U.S. international nuclear commercial leadership as part of the 'Team USA' approach, that was proposed by the Civil Nuclear Energy Trade Advisory Committee (CINTAC)." The International Subcommittee met with a set of government and private sector organization to obtain their input. Based on this input and the deliberations of the Subcommittee the following recommendations were given to NEAC and passed on to DOE/NE.

- U.S. nuclear energy leadership should be projected through enhanced education, safety and safeguards training, collaborative R&D, and regulatory collaboration and training. These activities should be accomplished in a more proactive way, particularly to newcomer countries that are starting or about to start civil nuclear energy programs. This should have a distinct U.S. footprint similar to the more generic IAEA footprint.
- DOE should give greater confidence to new nuclear power entrants as well as established civil nuclear power countries in the once-through fuel cycle by promoting dry spent fuel storage more aggressively and consolidated interim storage to be followed by direct geological disposal as soon as is practical. Continue ongoing efforts on Comprehensive Fuel Services programs, especially those suggested by the "Blue Ribbon Commission on America's Nuclear Future" as part of a comprehensive nuclear waste management approach.
- DOE should work with the U.S. Department of Commerce (DOC) to rethink their approach for formal and "informal" advocacy for nuclear power companies when new opportunities arise. DOE/NE should work directly with the DOC within existing mechanisms or jointly develop new mechanisms to strengthen the advocacy approach. When there is a single U.S. company involved, DOC's traditional advocacy support can be very helpful. However, when multiple companies are involved, their advocacy is typically "vanilla," which is not helpful. It does not appear that the DOC fully appreciates the influence it can wield if it could be more flexible and proactive. Better understanding of the full spectrum of opportunities needs to be obtained so that a broader range of U.S. companies can get advocacy support, not just the big multi-national companies such as reactor vendors, architect/engineers, constructors, etc. New market opportunities include smaller consulting companies that act as advisors to emergent nations as they start their nuclear programs.
- The importance of a strong, knowledgeable, and independent nuclear regulatory body cannot be overly stressed. This has been a constant and well-articulated theme over the past few years since the Fukushima reactor accident. Since the nuclear industry is global and events anywhere in the world influence programs all over the world, it is vital that the United States continue to support this type of a regulatory body in countries with emergent civil nuclear power programs. Considering that the U.S. NRC is generally regarded as the "gold standard" of regulatory bodies, it is appropriate that it helps set the standard worldwide. DOE should work within existing mechanisms or help develop new mechanisms in cooperation with the NRC to accomplish the goal of this

recommendation. The funding for this increased NRC activity could be encompassed by the first recommendation above or by direct authorization from Congress.

- Financing support from the U.S. Export-Import (ExIm) Bank for new international nuclear projects is a critical factor in the success of U.S. companies. Without this financing it is doubtful that U.S. companies can compete with companies from other countries that are state owned or highly supported by their governments. DOE and the USG should work with Congress to ensure the continued authorization of the ExIm Bank.

In February 2015, the International Subcommittee was asked to review the existing bilateral and multilateral nuclear collaboration between the United States and China, and make recommendations as to potential approaches and mechanisms to increase the effectiveness of this collaboration to support U.S. objectives and initiatives, in particular as they relate to RD&D and the U.S. industry. Again, the International Subcommittee met with a set of government and private sector organizations to obtain their input on this topic. Based on this input, the following recommendations were provided to NEAC and passed on to DOE/NE.

- Nuclear power should be treated as a strategic matter and not be handled like other energy sources. As such, the DOE should develop a strategy for international collaborations in the peaceful uses of nuclear energy that is more than simply accepting opportunities as they arise. Today, collaboration is performed in silos that are not well coordinated. The coordination of activities under the auspices of such a plan across USG agencies would be the responsibility of the National Security Council (NSC) staff, but DOE can be the principal drafter of this strategic plan in cooperation with other U.S. agencies.
- DOE should look for opportunities for its laboratories, universities, and/or U.S. vendors to perform analytical collaborative benchmark problems (similar to those periodically performed under the auspices of the IAEA) on both LWR commercial reactor designs and advanced reactors to maintain critical skills and keep abreast of the latest Chinese designs. This is the type of work that can help ensure new Chinese designs meet the highest international standards of safety.
- Understanding the importance for the USG to remain involved in many aspects of nuclear energy globally, nevertheless the DOE should decide which of the various reactor technologies make the most sense from a U.S. policy perspective and channel the vast majority of laboratory and other resources into those areas. Thus, DOE should encourage collaborations that further the goals in the strategic plan through use of its considerable resources.

Appendix D – NEAC International Subcommittee Activities on Current Charge

Meetings Held

- October 18 – 19, 2016
- November 21, 2016
- February 22 – 23, 2017

Organizations from Which Information Was Obtained

- Department of Energy (DOE) – Office Nuclear Energy
- Idaho National Laboratory (INL)
- Nuclear Energy Institute (NEI)
- United States Nuclear Infrastructure Council (NIC)
- Department of Commerce (DOC) - Civil Nuclear Trade Advisory Committee (CNTAC)
- General Electric-Hitachi (GE-H)
- Westinghouse Electric Company
- TerraPower
- Holtec International
- Bechtel Power

DOE NEAC International Subcommittee Meeting
Rom 5A-118, Atoms for Peace Conference Room
U.S. Dept. of Energy, 1000 Independence Ave., SW Washington, DC 20585
October 18-19, 2016
Agenda

DAY 1

1. Introductions, Review of New Charge (Task 1 and 2) to the International Subcommittee, Meeting Agenda, and Meeting Objectives 9:00
Regis Matzie, Chair and Ed McGinnis, Office of Nuclear Energy, Deputy Assistant Secretary for International Nuclear Energy Policy and Cooperation

2. Discussion of Other NEAC Related Charges on Advanced Reactors 9:30
Regis Matzie, Chair to Lead Discussion

3. NE Advanced Test Reactor Activities and International Aspects 10:30
Speaker: John Herczeg, Office of Nuclear Energy, Deputy Assistant Secretary for Nuclear Technology Research and Development

Discussion 10:45

Break 11:15

4. Update on Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative 11:30
Speaker: Shane Johnson, Office of Nuclear Energy, Deputy Assistant Secretary for Nuclear Technology Demonstration & Deployment

Discussion 12:15

Lunch 12:45

5. Review of Available Information of International Nuclear Facilities 1:30
Speaker: Appropriate Laboratory staff

- Review would include identification of gaps in capabilities of domestic facilities that might be filled by international facilities
- Describe the process whereby international facilities would contribute/leverage GAIN, including the flow of funding and existing cooperation mechanism

Discussion 2:30

Break 2:45

6. International Subcommittee Discussion on Task 2 3:00
Regis Matzie, Chair to Lead Discussion

Discussion 4:00

Adjourn 5:00

DOE NEAC International Subcommittee Meeting
Rom 5A-118, Atoms for Peace Conference Room
U.S. Dept. of Energy, 1000 Independence Ave., SW Washington, DC 20585
October 18-19, 2016

Agenda

DAY 2

1. Continued Discussion on Existing Data Related to Task 2 Regis Matzie to Lead Discussion	9:00
2. International Subcommittee Discussion on What Additional Information Is Needed to Answer Its Charge on Task 2 Regis Matzie to lead discussion	10:00
Break	10:50
3. Review of New Charge Task 1 Related Previous Recommendations from Past Charges Regis Matzie to lead discussion	11:00
4. Update on Team USA Speaker: Michelle Scott, Office of Nuclear Energy, Senior Advisor	11:30
5. Discussion of Approach to Undertaking Task 1 Regis Matzie to lead discussion	12:00
Lunch	1:00
6. Presentation by Nuclear Energy Institute (NEI): U.S. industry recommendations for actions that the USG should take to advance U.S. international commercial nuclear policies, priorities and exports Speaker: Carol Berrigan, Nuclear Energy Institute, Senior Director, Supplier Policy and Programs	2:00
Discussion	2:30
7. Presentation by Nuclear Infrastructure Council (NIC): U.S. industry recommendations for actions that the USG should take to advance U.S. international commercial nuclear policies, priorities and exports Speaker: David Blee, Executive Director, United States Nuclear Infrastructure Council (NIC)	3:00
Discussion	3:30
Adjourn	4:00

DOE NEAC International Subcommittee Meeting
Room 5A-118, Atoms for Peace Conference Room and Webex
U.S. Dept. of Energy, 1000 Independence Ave, SW Washington, DC 20585
November 21, 2016

Agenda

1. Introductions, Review of Agenda, Objectives of Meeting 8:45 am
Chair, Regis Matzie to Lead

2. DOE's Response to Prior Recommendations of this Subcommittee 9:00 am
Ed McGinnis Office of Nuclear Energy, Deputy Assistant Secretary for International Nuclear Energy Policy and Cooperation to Lead

3. Presentations by Commercial Companies on How NE Could Further Support USG International Commercial Nuclear Policies and Priorities 10:00 am
Most speakers will call-in or use WebEx to participate

- Civil Nuclear Trade Advisory Committee (CINTAC) - Gary Wolski, Former Vice Chair 10:00-10:30
- General Electric - David Sledzik, Vice President, Sales & Commercial Operations, Nuclear Projects 10:30-11:10
- TerraPower - Dr. Kevan Weaver, Director, Technology Integration 11:10-11:50
- Holtec International - William Woodard, Senior Vice President, International Projects 11:50-12:30
- Westinghouse - Graham Cable, Vice President, Global Market Development, New Plants and Major Projects 12:30-1:10

Working Lunch to Discuss New Charge Task 1 1:10-2:10

- Bechtel Power – Ahmet Tokpinar, Vice President Business Development and Commercial 2:10-2:50

4. Subcommittee Follow up on New Charge Task 1 2:50-3:20
Regis Matzie to Lead Discussion

5. Status of NEAC Int. Subcommittee New Charge Task 2 3:20-3:30
Regis Matzie to Lead Discussion

6. Discussion on Status of NEAC New Test Reactor Charge 3:30-4:00
Regis Matzie to Lead Discussion

Adjourn 4:00

NEAC International Subcommittee Meeting
U.S. Department of Energy, Washington D.C.
Forrestal Building, Room GH-019
February 22 – 23, 2017

Agenda

DAY 1

1. Arrival and Badging 8:45 – 9:00
Coffee and donuts will be provided

2. Introductions, Review of Agenda, Purpose of Meeting 9:00 – 9: 15
Regis Matzie, Chair

3. Remarks 9:15 – 9:30
Ed McGinnis, Office of Nuclear Energy, Deputy Assistant Secretary,
International Nuclear Energy Policy and Cooperation

4. *Task 2 of June 2016 Charge Letter:*
Review past efforts by the national laboratories to identify and catalog the international nuclear facilities and their major capabilities with the objective of analyzing gaps and what is needed to leverage the GAIN Initiative.

5. Presentation to Address Task 2 9:30 – 10:30
Corey McDaniel and Harold McFarland, Idaho National Laboratory

Break 10:30 – 10:45

6. Live Examination of Nuclear Energy Infrastructure Database (NEID) 10:45 – 11:30

7. Discussion on Task 2 including approach to identifying gaps 11:30 – 1:00

Lunch (not provided) 1:00 – 1:30

8. Discussion of Findings and Recommendations for Task 2 for the NEAC Report 1:30 – 3:00

Break 3:00 – 3:15

9. Continue Discussion on Subcommittee Report to NEAC 3:15 – 5:00

Adjourn 5:00

NEAC International Subcommittee Meeting
U.S. Department of Energy, Washington D.C.
Forrestal Building, Room GH-019
February 22 – 23, 2017

Agenda

DAY 2

1. Arrival and Badging *Coffee and donuts will be provided*	8:45 – 9:00
2. Remarks Regis Matzie, Chair	9:00 – 9:15
3. Review and Comment on Existing Draft Report	9:15 – 10:30
Break	10:30 – 10:45
4. Review and Comment on Existing Draft Report (cont'd)	10:45 – 12:00
5. Working Lunch	12:00 – 1:00
Adjourn	4:00

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