Written Testimony of
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Subcommittee on Energy

Hearing Entitled:

DOE Modernization: Advancing the Economic and National Security Benefits of America's Nuclear Infrastructure

February 6, 2018

Summary of Testimony

Chairman Upton, Ranking Member Rush, and distinguished members of this subcommittee, thank you for holding this hearing and for giving me the opportunity to testify. My name is Ashley Finan, and I am Policy Director for the Nuclear Innovation Alliance (NIA), a non-profit organization dedicated to supporting entrepreneurialism and accelerated innovation and commercialization of advanced nuclear energy systems.

The world will increase its energy demand by 40% or more by 2050, driven by an emerging middle class in the developing world and the need to bring electricity to 1.2 billion people who lack it today. At the same time, it is well understood that clean energy is essential to human health and many analyses point to the pressing need to drastically reduce global carbon emissions if we are to avoid the worst impacts of climate change. Nuclear energy will play a vital role in a future energy supply that addresses these priorities. The question for us is: will the United States be a part of that?

In the U.S. and elsewhere, start-up companies are pioneering advanced nuclear designs that offer opportunities for increased safety and affordability, enhanced nonproliferation attributes, and a reduction in nuclear waste. These designs can revolutionize the nuclear industry and revitalize U.S. exports with products that take advantage of the latest manufacturing and computing technology, that are competitive in markets across the globe, and that exceed the expectations of customers and the public.

But the transition from design to commercialization and deployment has been hampered by significant underinvestment in research, development, and demonstration, a slow and underprepared licensing process, and long and lengthening export control processes.

The government plays several roles in the commercialization and export of a nuclear energy technology. It is a research collaborator, development supporter, demonstration partner, regulator, and promoter. In turn, as with any new technology, the nation profits from the economic impact of the product and the exports and jobs it creates. Unique to nuclear energy, though, are several other benefits: century-long strategic trade relationships with customer countries, reliable clean energy to fuel domestic and global prosperity, and stronger U.S. influence over global nuclear safety, security, and nonproliferation standards.

We have not seen a booming U.S. nuclear export business in decades. Not least among many causes is the lack of a compelling nuclear energy product from the private sector. The market

demands plants that are more resilient and flexible, lower impact, and simpler and cheaper to build and operate. As I touched on earlier, companies are answering that call, and they are innovating. They are finding a U.S. government that is curious, and interested, but not wholly invested, and not always ready to innovate.

Meanwhile, Russia is building a fast test reactor to replace its retiring predecessor, as well as a lead fast reactor to join its two operating sodium fast reactors. China is simultaneously running several major R&D and demonstration programs and its commercial high temperature gas reactor will be connected to the grid this year. India's prototype fast breeder reactor will also enter operation this year.

This does not need to devolve into a geopolitical race. But it is a harsh reality of business that if we are last to market we are likely to become irrelevant. And it is a harsh reality of global nuclear security that the countries supplying nuclear power have the strongest hand in influencing how nuclear programs are protected from misuse and how safely those programs are run.

Currently, NRC licensing of advanced reactor technology is fraught with major challenges, as described in detail in my written testimony.[1] The NRC has begun addressing these challenges, and has made progress, but they have done so with extraordinarily limited resources. This work needs to be pursued with dedicated funding and with urgency.

Export application decisions through DOE's Part 810 specific authorization process took on average about 150 days between 2000 and 2004. By 2014 the average was over 400 days, with some decisions taking over 900 days. Specific authorization is required for sales in certain countries, but it is often required very early in the marketing process to allow companies to share information with potential customers. Long processing times make it more difficult for U.S. companies to compete. The NIA has proposed actions to improve these timelines in its "Part 810 Reform" report, including fast-track authorization pathways for specified activities and destinations, and changes to DOE's processing structure.[2]

To secure a leadership position in the global nuclear market, the U.S. needs to move its designs from development to demonstration and deployment. The NIA made recommendations in its "Leading on SMRs" report: Congress and the administration should expand support for the development of first-of-a-kind demonstration projects and should pursue federal power purchase agreements to provide a market for clean and secure energy.[3]

The private sector cannot do this alone, and it is time for government to move from being interested to being invested. It is time for government to act with urgency and to support innovation earnestly.

Thank you for this opportunity to testify. I would be pleased to respond to any questions you might have, today or in the future.

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[1] See also: *Enabling Nuclear Innovation: Strategies for Advanced Reactor Licensing*, Nuclear Innovation Alliance 2016. https://www.nuclearinnovationalliance.org/advanced-reactor-licensing

[2] *Enabling Nuclear Innovation: Part 810 Reform*, Nuclear Innovation Alliance 2017. https://www.nuclearinnovationalliance.org/part810reform

[3] Enabling Nuclear Innovation: Leading on SMRs, Nuclear Innovation Alliance 2017. https://www.nuclearinnovationalliance.org/leadingonsmrs

Full Written Testimony

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The world will increase its energy demand by 40% or more by 2050, driven by an emerging middle class in the developing world and the need to bring electricity to 1.2 billion people who lack it today. At the same time, many analyses point to the pressing need to drastically reduce global carbon emissions if we are to avoid the worst impacts of climate change, and clean air is essential to human health. Nuclear energy will play a vital role in a future energy supply that addresses these priorities. The question for us is: will the United States be a part of that?

In the U.S. and elsewhere, start-up companies are pioneering advanced nuclear designs that offer opportunities for increased safety and affordability, enhanced nonproliferation attributes, and a reduction in nuclear waste. These designs can revolutionize the nuclear industry and revitalize U.S. exports with products that take advantage of the latest manufacturing and computing technology, that are competitive in markets across the globe, and that exceed the expectations of customers and the public.

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We have not seen a booming U.S. nuclear export business in decades. Not least among many causes is the lack of a compelling nuclear energy product from the private sector. The market demands plants that are more resilient and flexible, lower impact, and simpler and cheaper to build and operate. As I touched on earlier, companies are answering that call, and they are innovating. They are finding a government that is curious, and interested, but not wholly invested, and not always ready to innovate.

Meanwhile, Russia is building a fast test reactor to replace its retiring predecessor, as well as a lead fast reactor to join its two operating sodium fast reactors. China is simultaneously running several major R&D and demonstration programs and its commercial high temperature gas reactor will be connected to the grid this year. India's prototype fast breeder reactor will also enter operation this year. The U.S. has neither a fast test reactor needed to

support basic R&D nor any advanced reactor demonstrations that would support eventual commercialization of a new technology.

This does not need to devolve into a geopolitical race. But it is a harsh reality of business that if we are last to market we are likely to become irrelevant. And it is a harsh reality of global nuclear security that the countries supplying nuclear power have the strongest hand in influencing how nuclear programs are protected from misuse and how safely those programs are run.

Two of the most critical barriers to success are the lack of a clear and efficient pathway for a first demonstration project, and continuing doubt that the Nuclear Regulatory Commission (NRC) will be able to issue a license for a non-light water reactor in a time frame compatible with private-sector needs. *These obstacles **must** be addressed before we can realize the benefits of the next generation of nuclear technology*.

Many other hurdles exist, including technology challenges, supply chain limitations, a difficult market environment, inaction on nuclear waste management, and restrictions on international cooperation. In addition, clean air policy must be updated to recognize the benefits of nuclear power. Progress on all of these fronts is urgently required. The following three sections provide detailed recommendations in the areas of advanced reactor licensing, export control reform, and demonstration incentives.

Advanced Reactor Licensing

Current NRC regulation confronts the licensing of advanced technologies with two major challenges. First, NRC design certification or approval calls for enormous front-loaded investment during a protracted development and licensing phase—without a staged structure to provide applicants with clear, early feedback on an agreed schedule. Second, current regulation primarily evolved to oversee light water reactor (LWR) technologies. It must be adapted to the features and performance characteristics of advanced reactors, which rely on substantially different fuels, cooling systems, and safety strategies, and require novel operating strategies.

Figure 1 illustrates the investment challenge showing schematically the risk/investment profile of nuclear energy projects relative to the licensing process today, and the large monetary and temporal hurdle of obtaining design approval.

Figure 1: Current Project Risk/Investment Profile Relative to Licensing

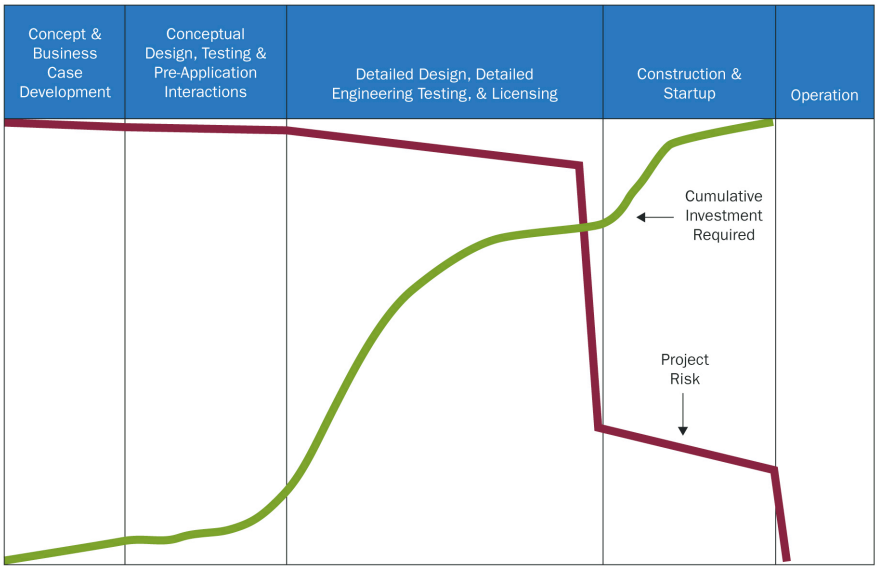
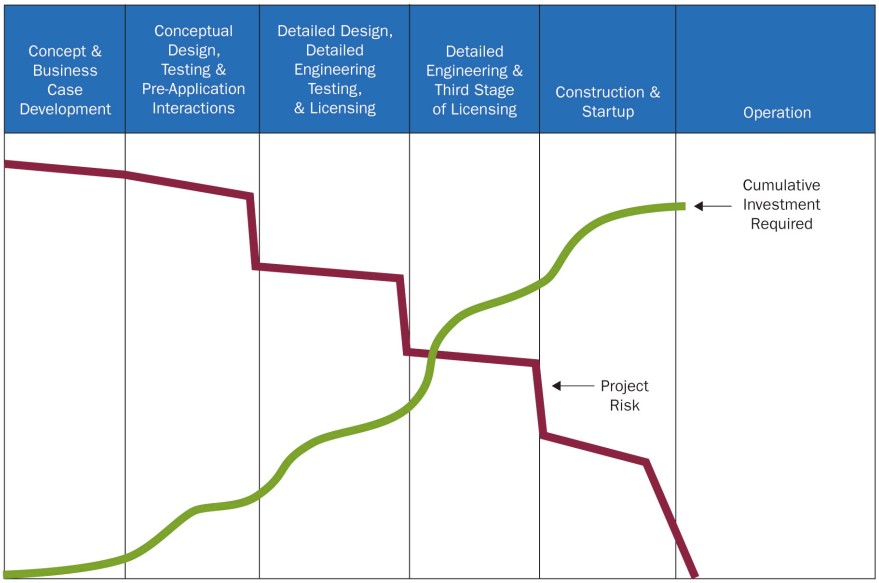


Figure 2 illustrates a staged approach – one that would update the current process to be more aligned with private sector development of innovative technology using a regulatory engagement plan, topical reports, and other existing mechanisms; and one that would offer clear and early feedback to investors and developers through an optional conceptual design assessment. This approach maintains the rigor and high standards of the NRC and facilitates the development of safer nuclear technology that produces less waste, or even consumes it.

Figure 2: Desirable Project Risk/Investment Profile Relative to Licensing



This approach can be achieved using existing regulatory tools at the NRC, with some adjustments in the NRC's approach and the development of additional guidance. The NRC has already begun doing this work, and has made considerable progress in the past year, but they have done so with extraordinarily limited resources. This work needs to be pursued with dedicated funding and with urgency. The Advanced Nuclear Technology Development Act

of 2017 (H.R. 590) is one bill that authorizes the NRC to do the crucial work to modernize the licensing process and prepare for new technologies with dedicated funding.

Over the past several years, the NIA has been developing strategies to facilitate the efficient, cost-effective, and predictable licensing of advanced nuclear power plants in the United States. These strategies are based on consultations with nuclear innovators, safety experts, former NRC staff and Commissioners, members of the financial community, and other nuclear industry stakeholders. The NIA also examined nuclear reactor licensing systems in the United Kingdom and Canada, and scrutinized analogous regulatory systems administered in the United States by the Federal Aviation Administration and the Food and Drug Administration. We compiled the results of some of our work into a report called "Enabling Nuclear Innovation: Strategies for Advanced Reactor Licensing," which was issued in April 2016. The report is available to the public on the NIA website. It discusses in much greater detail the points discussed in this testimony. The following three recommendations are highlighted here:

> **Recommendation 1:** Congress should revise the NRC's budget structure so that, instead of a 90% fee-based, 10% public funding model, licensees and applicants reimburse the NRC for activities related to their regulation, with Congress funding other agency-related activities—including the development of new regulations for advanced technologies, R&D, international programs, and other initiatives not related to a specific licensee. The nuclear fleet operating today was licensed by an NRC that had been fully funded by Congress, before the advent of current fee-recovery rules. Unlike that earlier generation of reactors, licensing of the AP1000s now under construction has been supported by substantial cost-shared funding from DOE. To prepare for the licensing of advanced reactors, the NRC faces a greater challenge that will require consistent public funding.
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> **Recommendation 2:** Congress should authorize and appropriate funds for the NRC to prepare for advanced reactor licensing, including but not limited to:
>
> - Development and implementation of strategies to stage and expedite the advanced reactor licensing process;

- Development and implementation of risk-informed, performance-based licensing strategies for advanced non-light water reactors;
- Efforts to prepare the process of licensing advanced demonstration reactors; and
- Staff training or the hiring of experts.

Recommendation 3: To expand available financial resources for advanced reactor companies, Congress should continue to fund DOE to competitively award grants for early efforts to license advanced reactor companies, including but not limited to:

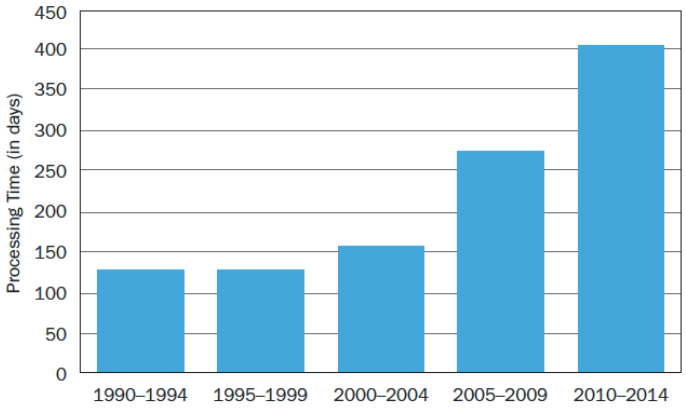
- Pre-application engagement with the NRC;
- Developing a regulatory engagement plan; and
- Applying for a conceptual design assessment or similar early-stage design review.

The DOE Gateway for Accelerated Innovation in Nuclear (GAIN) initiative's small business voucher program is one possible mechanism for this.

Export Control Reform

10 CFR Part 810 (Part 810) regulates the export of nuclear energy technology and unclassified assistance to foreign nuclear energy programs. The U.S. Department of Energy (DOE) now takes significantly longer to process applications for specific authorization under Part 810 (see Figure 3) than it did in the 1990s. Industry has stated that the lengthened processing times constitute a significant competitive disadvantage.

Figure 3: Average Processing Time for Specific Authorization Applications



In the 1990s, specific authorizations took on average 130 days to process. One contributing factor to the recent increase in processing time is a change in processing structure at DOE: previous to 2005, specific authorizations were signed by the Secretary of Energy "subject to the receipt of assurances" from foreign governments. This allowed the U.S. government to process applications for specific authorization while simultaneously seeking assurances from foreign governments. After 2006, this parallel approach was transitioned to a longer serial process, in which the DOE awaits receipt of assurances before completing its own review. The following three recommendations from the NIA's "Part 810 Reform" report are highlighted here:

> **Recommendation 1:** DOE should return to the pre-2005 process under which the Secretary of Energy signs determinations subject to the receipt of assurances. At a minimum, DOE should continue to process specific authorization applications while the interagency review process is ongoing and assurances are being sought by the State Department so that determinations are ready for the Secretary of Energy to sign immediately afterwards.
>
> **Recommendation 2**: DOE should initiate a rulemaking to establish two fast track authorization pathways for specified activities in countries that have made significant nonproliferation commitments. One authorization should focus on applications that need government to government assurances, and a second should involve applications that do not require such assurances. In both cases, DOE should establish the types of

activities that qualify for fast track approval, along with a list of countries eligible for expedited consideration.

Recommendation 3: DOE should re-examine its legal position that delegation of authority by the Secretary of Energy for activities under Section 57b is prohibited by Section 161n of the Atomic Energy Act of 1954 (AEA), as amended; if necessary, DOE should request that Congress amend Section 161n of the AEA to permit delegation.

A more detailed discussion of the NIA's recommendations is presented in Appendix A, which is the executive summary of the "Part 810 Reform" report.

Support for First-of-a-Kind Demonstration Projects

A critical obstacle to financing innovative nuclear power technologies is that there is no clear pathway for a first pilot-scale or larger demonstration reactor. Early demonstration reactors were heavily financed and overseen by the federal government. Advanced reactors under development today are likely to be demonstrated by privately-led coalitions, but government sites and other resources will be indispensible; new arrangements between DOE (or DOD) and the private sector will be needed. High assay low enriched uranium will be important for some early advanced reactor fuel, and the government could supply that from existing stocks. The Gateway for Accelerated Innovation in Nuclear (GAIN) is a promising platform; through ongoing support, growth, and stakeholder involvement, GAIN can enable private sector innovation and demonstration. By providing a policy, funding, and testing platform for qualified nuclear innovators, the risk, cost, and difficulty of first pilot-scale demonstrations could be greatly reduced, accelerating the innovation process.

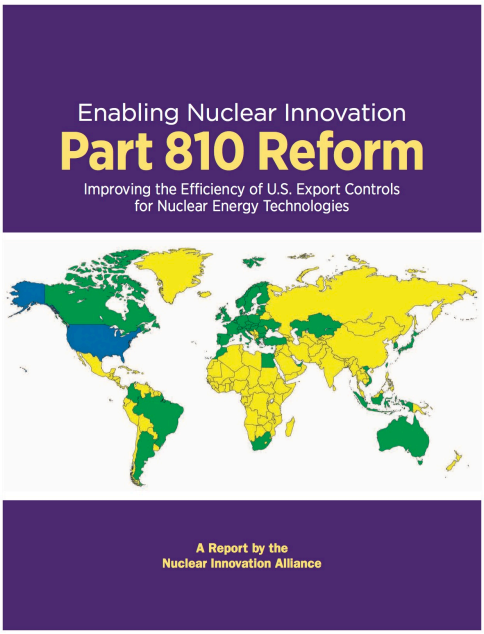
Domestic nuclear innovation would move faster if the federal government provided both a technology "push" in the form of grants or favorable cost-sharing programs for early-stage

reactor development and licensing costs, and a "pull" in the form of long-term power purchase agreements or other incentives for first-of-a-kind innovative commercial reactors. Because of the unique financial and technology risks associated with commercializing advanced nuclear technologies, this kind of broad-based support would encourage more innovators to enter the market, accelerate development of designs, and improve the chance of game-changing technologies reaching the global energy market.

To secure a leadership position in the global nuclear market, the U.S. needs to move its designs from development to demonstration and deployment. The NIA made recommendations in its "Leading on SMRs" report, the executive summary of which is presented in Appendix B.

These policies will not be enough on their own – nuclear innovators will need to succeed in realizing dramatic cost reductions and in demonstrating energy technology that is versatile, robust, simple to operate and quick to build. This will require new approaches, some of which may succeed while others may not. Both the public and private sectors will need to commit to an aggressive and unconventional approach; the rewards are well worth the investment.

Thank you for this opportunity to testify on behalf of the Nuclear Innovation Alliance. The NIA is pleased to work with the Committee to advance U.S. leadership in nuclear energy innovation.



APPENDIX A

EXECUTIVE SUMMARY

THE U.S. ENERGY INFORMATION Administration (EIA) projects that by 2050 countries around the world will add almost 200 gigawatts of new nuclear energy capacity.[1] Those construction projects will entail the flow of new nuclear materials, services, and equipment to a number of countries that currently do not possess significant nuclear power programs. A growth in nuclear energy use offers major commercial opportunities for nuclear reactor companies and carries implications for the global nonproliferation regime. As Table 1 shows, most of the expected deployments are projected to take place in countries that are not members of the Organisation for Economic Co-operation and Development (OECD).

In the United States, this intersection of business and national security takes place under the U.S. Department of Energy (DOE) 10 CFR Part 810 (Part 810) regulations.

Before the first reactors are under construction, however, supplier nations typically share proprietary information on their reactor designs with potential customer nations. These transactions may be the first technology transfers where the government of a supplier nation will have to consider the commercial and nonproliferation implications of broader nuclear energy cooperation with a first-time nuclear energy customer nation. Even between countries where nuclear trade has been ongoing for decades, new transactions such as these may pose unique and complex challenges.

In the United States, this intersection of business and national security takes place under the U.S. Department of Energy (DOE) 10 CFR Part 810 (Part 810) regulations, which control the flow of unclassified nuclear energy technology and assistance to foreign atomic energy activities. These regulations and their implementation are the subject of this report.

Activities regulated by Part 810 are largely divided between those that are generally authorized —that is, companies do not have to ask the U.S. government for permission—and those that require specific authorization from the Secretary of Energy. In recent years, U.S. officials have taken longer to process applications for specific authorization (see Figure 1) to the point where industry has stated that it constitutes a "significant competitive disadvantage" for U.S. companies.[2] DOE has recognized this issue and begun a process improvement plan; however there are challenges associated with Part 810 reform that may need assistance from Congress and industry.

In the 1990s, specific authorizations took on average 130 days from receipt of the application by DOE to final approval by the Secretary of Energy. As Figure 1 shows, applications for specific authorization in more recent years are taking an average of close to 400 days to complete the process. One contributing factor to the increased processing time is a change in processing structure at DOE: previous to 2005, specific authorizations were signed by the Secretary of Energy "subject to the receipt of

1 EIA, "International Energy Outlook 2017."

2 Comments of Nuclear Energy Institute, DOE Supplemental Proposed Rule, November 27, 2013. Page 10.

TABLE 1
EIA Projections for Additional Nuclear Energy Capacity by Region (capacity in gigawatts)

Region	2015	2030	2050	Change from 2015 to 2050
OECD Countries	256	259	200	-56
Non-OECD Europe and Eurasia	42	57	56	+14
Non-OECD Asia	39	124	231	+192
Non-OECD Americas	4	6	5	+1
Africa	2	4	6	+4
Middle East	1	12	17	+16
Total	**343**	**462**	**516**	**+173**

Source: EIA, "International Energy Outlook 2017," Table H5.

assurances" from foreign governments. This allowed the U.S. government to process applications for specific authorization while seeking assurances from foreign governments. The pre-2005 process was more efficient and facilitated a swifter response to U.S. companies whose applications were pending.

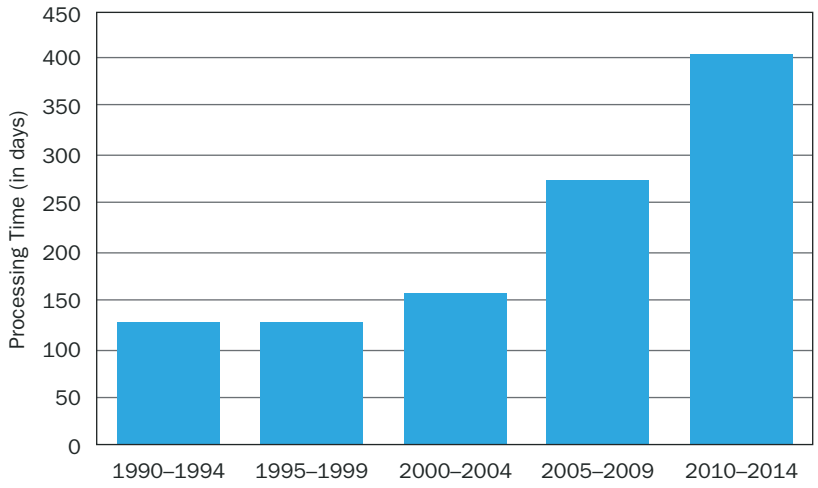
Government to government assurances are requested as part of each specific authorization.[3] The United States is obligated, as part of its adherence to the Nuclear Suppliers Group (NSG) Trigger List Guidelines, to obtain two types of assurances for nuclear technology transfers. These obligations require 1) assurances of peaceful uses for transferred technology and 2) assurances regarding any subsequent retransfer of the supplied technology.[4] The major nuclear supplier nations are also members of the NSG, and thus U.S. competitors have the same obligations to obtain assurances for nuclear energy technology transfers.

The current uncertainty in application processing times is challenging for U.S. companies as the application process may take 200 days or it may take 600 days or longer. One source of that uncertainty is that the U.S. government cannot control the response time of foreign governments supplying the requested assurances regarding peaceful uses and retransfers. In some cases, foreign governments have taken more than two years to supply the requested assurances.

When compared to other major supplier export control regimes, Part 810 is more efficient regarding activities that are generally authorized, but less efficient in some cases regarding specific authorizations. A 2012 report examined the export control regimes of foreign competitors—the Republic of Korea (ROK), Russia, Japan, and France—and noted that the stated periods in which government entities were required to process export control applications were 15 days, 25-45 days, 90 days, and nine months, respectively. If these periods correspond even roughly with actual specific authorization application processing speeds, then these nations are significantly faster than the specific authorization process under Part 810. Furthermore, it is likely that some other major suppliers are able to obtain approvals or denials in a shorter period of time than Part 810 specific authorizations, due to the fact that many suppliers are state-owned.

Other federal regulatory regimes offer potential templates for improving the efficiency of Part 810.

FIGURE 1
Average Processing Times for Specific Authorization Applications



Source: DOE reading room.

3 The one exception is the hiring of foreign nationals by U.S. companies, which is discussed in Chapter III.

4 See *http://www.nuclearsuppliersgroup.org* for the most recent documentation.

The U.S. Nuclear Regulatory Commission (NRC), for example, regulates the export of nuclear material and equipment under the 10 CFR Part 110 (Part 110) regulations. These regulations have a more risk-informed structure than Part 810 and include many different categories of exports, multiple country lists, processing structures, and levels of review depending on the significance of the proposed export. Some export applications are sent to the NRC commissioners for review, while others are not; likewise, some applications are sent to the Executive Branch for its views, based on a de facto assessment of risk or policy significance, while other applications are not. By contrast, the Secretary of Energy's attention and signature is currently required for even minor applications and amendments under Part 810; this process adds weeks or even months of additional processing time, often with no clear benefit.

The NRC has established a general license for minor reactor components to countries "sharing U.S. nonproliferation goals" and which had supplied the United States with generic assurances—in other words, certain minor exports have been expedited to countries with good nonproliferation credentials.

The NRC has also established a general license for minor reactor components to countries "sharing U.S. nonproliferation goals" and which had supplied the United States with generic assurances. In other words, certain minor exports have been expedited to countries that have demonstrated their nonproliferation credentials. This was done in part to reduce the regulatory burden on U.S. companies and NRC staff, but also to benefit U.S. nonproliferation objectives by demonstrating to other countries the advantages of supporting nonproliferation policies.

Likewise, the U.S. government should establish "fast track" approval pathways under Part 810 for countries that have made and are maintaining significant nonproliferation commitments (see Appendix A for an example list of possible countries and criteria). One criterion for determining which countries qualify for fast track eligibility could be previous authorizations under Part 810, which clearly indicate U.S. intent to cooperate on nuclear energy. Such a criterion would be similar to how the NRC exempts review by the NRC commissioners in some cases for subsequent Part 110 exports to a country or reactor after an initial export. A new "fast track" approval pathway would also need to identify eligible activities: for example, light-water reactor (LWR) technology could be given expedited consideration, considering its widespread deployment and availability from multiple suppliers.

China, India, and Russia are the only countries that have nuclear cooperation agreements in place with the United States, and yet are not generally authorized destinations under Part 810, owing to various geostrategic considerations. U.S. companies have required specific authorization to work with Chinese and Russian entities since the regulations were first issued in 1956, and with Indian entities since 1983. China is projected to build more than half of new global nuclear generation capacity over the next three decades, making it the most attractive market for nuclear companies worldwide to seek business opportunities. The U.S. government is concerned with technology transfers to China, however, for reasons that include: China's nuclear energy cooperation with Pakistan, whether or not China is maintaining its nonproliferation commitments, intellectual property issues, and potential diversions of civil nuclear energy technologies to military activities (e.g., naval reactor programs).

The following actions (discussed in greater detail in Chapter VI) are recommended[5] to improve the efficiency of U.S. export control regarding nuclear technology transfers and other unclassified assistance to foreign nuclear energy programs:

Recommendation 1: *DOE should initiate a rulemaking to establish two fast track authorization pathways for specified activities in countries that have made significant nonproliferation commitments. One authorization should focus on applications that need government to government assurances, and a second should involve applications that do not require such assurances. In both cases, DOE should establish the types of activities that qualify for fast track approval,*

5 This report does not represent a legal opinion, nor does it offer advice of counsel for the Nuclear Innovation Alliance. Readers should consult with counsel for legal advice and direction, and with the National Nuclear Security Administration, a component of the U.S. Department of Energy, to obtain guidance on activities subject to the regulations discussed in this report.

along with a list of countries eligible for expedited consideration.

The Part 810 regulations already include a type of fast track authorization for operational safety activities in Section 810.6(c)(2). This section provides authorization for furnishing "operational safety information or assistance to existing safeguarded civilian nuclear reactors outside the United States in countries with safeguards agreements with the International Atomic Energy Agency (IAEA) or an equivalent voluntary offer, provided DOE is notified in writing and approves the activity in writing within 45 days of the notice." Given the type of activity (operational safety assistance to IAEA safeguarded reactors) and type of destination (countries with safeguards agreements with the IAEA or an equivalent voluntary offer) the expectation is that a given application will be approved, though the process still affords the U.S. government an opportunity to review and potentially reject the application.

Following the model in Section 810.6(c)(2), the new pathways would allow companies to notify DOE that they are intending to pursue specific activities and if they do not hear back from DOE after a specified amount of time (e.g., 45 days), the activity would be deemed to be approved (pending receipt of assurances for authorizations where they are needed).

Recommendation 2: *The White House should issue an Executive Order that affirms the importance of efficient processing of Part 810 applications to U.S. commercial and national security interests, and directs improvements toward that aim.*

As a model, the new Executive Order should look to Executive Order 12981, which governs the export of dual-use items. Executive Order 12981 set out timelines for agency actions, as well as provisions for handling incomplete applications and establishing mechanisms to resolve interagency disputes.

The Executive Order for Part 810 should state that it is the policy of the U.S. government to continue processing applications for specific authorization while government assurances are being sought (for the cases where assurances are necessary).

Recommendation 3: *For specific authorization applications, DOE should return to the pre-2005 process under which the Secretary of Energy signs determinations subject to the receipt of assurances. At a minimum, DOE should continue to process Part 810 packages while the interagency review process is ongoing and assurances are being sought by the State Department, so that applications are before the Secretary of Energy and ready to be signed as soon as possible upon receipt of the assurances.*

Returning to the pre-2005 policy, under which the Secretary signs determinations subject to the receipt of assurances, would provide U.S. companies an earlier notification that the U.S. government has approved the activity, pending the receipt of foreign government assurances. This would reduce uncertainty for U.S. businesses and accelerate specific authorization approvals without a reduction in nonproliferation controls.

Recommendation 4: *The DOE Offices of Nonproliferation and Arms Control, Nuclear Energy, and Intelligence should prepare a classified report analyzing the risks and benefits of nuclear energy technology transfers with China to provide a framework for future internal U.S. government discussions.*

An assessment of the nuclear energy technologies available and being supplied to China from other countries (e.g., Russia, France, Japan), along with China's own independent R&D progress, would provide additional context for a balanced accounting of the risks and benefits associated with specific authorizations to China.

DOE should return to the pre-2005 process under which the Secretary of Energy signs determinations subject to the receipt of assurances. This would reduce uncertainty for U.S. businesses and accelerate specific authorization approvals without a reduction in nonproliferation controls.

Recommendation 5: *The U.S. Department of State should seek generic assurances from countries, where possible, to cover transfers under Part 810 before applications for export are submitted.*

The U.S. government should seek generic assurances from individual countries for some of the more minor exports under Part 810. DOE could then process applications to countries more quickly, perhaps in combination with a fast track approval process, as the assurances step would already be completed.

Recommendation 6: *DOE should re-examine its legal position that delegation of authority by the Secretary of Energy for activities under Section 57b is prohibited by Section 161n of the Atomic Energy Act of 1954 (AEA), as amended.*

The Secretary of Energy currently signs off on every new specific authorization, no matter how minor, as well as extensions and minor amendments to existing authorizations, because of DOE's legal interpretation of Section 161n as prohibiting delegation by the Secretary to others. This adds weeks, if not months, to the processing of specific authorization applications with no obvious benefit. It is difficult to see why the Secretary of Energy's attention is needed or useful in any way for approving the hiring of foreign nationals, minor amendments to existing authorizations, renewals of authorizations, or other relatively technical or small-scale activities, such as operational consultations to existing LWRs under IAEA safeguards.

The delegation of minor activities by the Secretary of Energy and an expedited review for activities of lesser significance are both consistent with nuclear export control practices elsewhere in the federal government.

For comparison, the NRC Commissioners do not review most applications for the export of materials and equipment under the NRC's Part 110 regulations, and the NRC does not send most Part 110 applications to the Executive Branch for review. In other words, the delegation of relatively minor activities by the Secretary of Energy and an expedited review for activities of lesser significance, are both consistent with nuclear export control practices elsewhere in the federal government.

Recommendation 7: *If DOE continues in its determination that delegation of authority by the Secretary of Energy for activities under Section 57b is prohibited by Section 161n, Congress should amend Section 161n of the AEA to permit delegation, recognizing the very different global reality today as compared with 1954, as well as the minor activities that are currently being sent to the Secretary of Energy.*

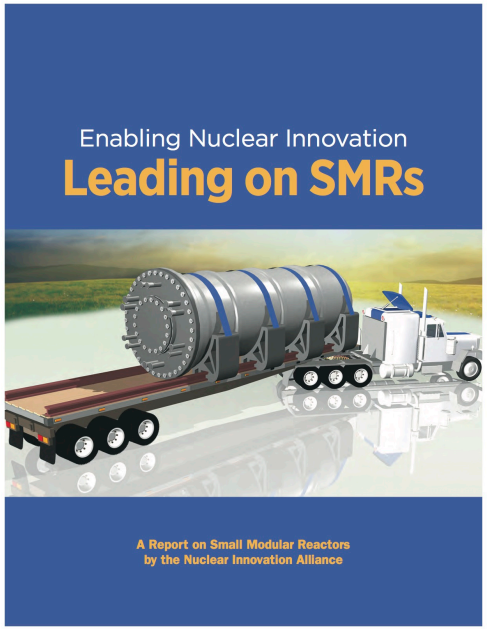
Recommendation 8: *Advanced reactor companies that intend to pursue work with foreign entities should engage DOE on Part 810 early in a similar manner to the pre-application interactions with the NRC on reactor design licensing.*

Early engagement between advanced reactor companies and DOE would familiarize the U.S. government with the technologies involved and also the end users under consideration. These interactions would provide early feedback to U.S. reactor companies on potential challenges with specific destinations and end users, as well as any concerns with the reactor technology itself.

Recommendation 9: *Industry should create a forum to share Part 810 experiences for the purpose of raising the quality of applications that are submitted to DOE.*

Companies that are new to the Part 810 process would especially benefit from hearing more experienced companies explain what information the U.S. government needs to process applications. This should help to cut down on processing times and reduce the resources expended by both private companies and the U.S. government.

APPENDIX B



EXECUTIVE SUMMARY

A central challenge in the 21st Century is how to lift billions of people out of poverty without long-term damage to human health and the environment. Increased energy use has been linked to improvements in quality of life, and one consequence of that connection is clear: worldwide demand for energy, especially in the developing world, is predicted to increase substantially out to 2050. Fossil fuels currently supply roughly 85% of the energy that drives the world economy. With the traditional use of that energy source, however, comes serious air pollution and climate change risks. Nuclear energy is a dispatchable source of clean energy with decades of operational experience that could help to reduce these environmental risks, while supplying the energy necessary to spur economic growth that can advance quality of life worldwide. And one particular technology—small modular reactors (SMRs)—offers great promise.

Small modular reactors offer lower overall costs, shorter construction periods, and simplified designs that enhance safety.

In the past, the complexity of large light-water reactor designs contributed to construction delays, as it has with the most recent U.S. construction projects. SMRs offer lower overall costs, shorter construction periods, and simplified designs that enhance safety. They offer the potential to set new standards for passive nuclear energy safety in the U.S. commercial fleet, while their operational flexibility supports reliability of the electrical grid in an era of rising intermittent renewable energy generation. Through industrial heat applications, SMRs could potentially decarbonize sectors beyond electricity and contribute to nuclear/renewable hybrid energy systems.

In this report, SMRs are defined by their size, co-location of multiple modules, and approach to construction, rather than by coolant. In other contexts, SMRs may specifically mean light-water cooled designs, but here they include light-water cooled along with liquid metal, gas, and molten salt reactors. (See Chapter II: The Small Modular Reactor Option for further discussion.)

Natural gas combined cycle (NGCC) plants are the least expensive of any generation source in the current U.S. market, given the low price of natural gas. The levelized cost of electricity (LCOE) for a given energy technology is one measure of that technology's competitiveness against other energy sources.[1] The LCOE comparison for SMRs versus NGCC plants depends to a significant degree on the regulatory environment for electricity generation, as well as the specific financing structure for construction. While the LCOE for SMRs is much higher than NGCC plants in deregulated states, it narrows in other environments. Accounting for the cost of greenhouse gas emissions, SMRs can compete with NGCC plants in the public power sector. Adding SMRs to generating portfolios would also reduce utilities' exposure to natural gas price volatility.

1 As discussed in Chapter III, LCOE is an imperfect measure of an energy source's value, neglecting factors such as reliability, intermittency, and other issues.

Global public and private sector commitments to deploying cleaner energy technologies underlie various projections showing an increase of hundreds of gigawatts in nuclear energy capacity over the next 23 to 33 years. If SMRs capture even a small portion of total nuclear energy capacity worldwide, and move into process heat applications, the result will be tens of gigawatts or more of SMR deployment. Most of these builds will occur outside the United States, in the developing world, with likely three major SMR suppliers: China, Russia, and the United States. International opportunities could create or sustain hundreds of thousands of U.S. jobs.

The projected growth in nuclear energy generating capacity over the next several decades, including in countries that either do not have existing nuclear energy programs or have only very preliminary ones, has implications for the global nonproliferation regime. Since President Eisenhower's Atoms for Peace speech in 1953, the United States has seen a national interest in providing support for peaceful nuclear energy activities in exchange for a role in setting nonproliferation conditions. Government investment in the 1950s and 1960s paved the way for early U.S. global dominance of the nuclear energy markets, which in turn gave the United States an outsized role in setting nonproliferation supplier norms. With the coming expansion of nuclear power in the developing world, a renewed commitment to leadership in nuclear energy is needed to ensure a similar role for the United States once again.

Given the uncertainty in cost and availability for different nuclear reactor designs, the United States should provide a continuum of support through the different stages of reactor development and use the market to help guide technology down-selection. The federal government should also provide targeted incentives and support to leverage the specific regions and entities in the United States where nuclear energy is most attractive to achieve deployment of first-of-a-kind SMRs. Domestic deployment and U.S. Nuclear Regulatory Commission licensing will provide a marketing advantage to U.S. SMR companies seeking to gain a foothold in international markets. This will ensure that the United States has an active role in the development and evolution of the global nuclear energy and nonproliferation regime over the coming decades, which in turn will support U.S. national security interests.

To further these objectives, the following actions are recommended. (See Chapter VI: Recommendations for further details.) Additional research, development, and demonstration recommendations needed to support non-light water reactors will be described in greater detail separately.

Recommendation 1: Congress and the Administration should expand support for new reactor design and licensing to include non-light water designs and extend support through design finalization.

Recommendation 2: Congress should amend the nuclear energy production tax credit (PTC). *Congress should amend section 1306 of the Energy Policy Act of 2005 (EPACT05) to remove the in-service date of January 1, 2021, raise the cap to 9000 MW, allow nonprofit public power entities to qualify, and raise the payment rate for new deployments to 2.7 cents/kWh.*

Recommendation 3a: Congress should enable federal facilities to enter into power purchase agreements for low-emission technologies for periods of 20 years or greater.

Recommendation 3b: The Secretary of Energy should work with the Western Area Power Administration (WAPA) Administrator and the U.S. Department of Energy (DOE), the U.S. Department of Defense (DOD), and other federal facilities in the WAPA territory to procure 100–200 MW of power from the Utah Associated Municipal Power Systems (UAMPS) SMR project.

Recommendation 3c: The Secretary of Energy should work with the Tennessee Valley Authority (TVA) and DOE, DOD, and other federal facilities in the TVA territory to procure 100–200 MW of power from the TVA SMR project.

Recommendation 3d: DOE should identify options for federal power purchase agreements to help enable deployment of new reactor technologies.

Recommendation 4: States should expand any existing or proposed Renewable Portfolio Standards into Clean Energy Standards. *States should expand renewable portfolio standards into clean energy standards to increase the total amount of low-carbon electricity required and give utilities greater flexibility in reducing air pollution and greenhouse gas emissions, while also meeting reliability requirements.*