Testimony of Edwin Lyman, PhD

Senior Scientist, Union of Concerned Scientists

On "Enabling Advanced Reactors and a Legislative Hearing on S.2795,

The Nuclear Energy Innovation and Modernization Act."

Before the

Subcommittee on Clean Air and Nuclear Safety

Committee on Environment and Public Works

U.S. Senate

April 21, 2016

Chairman Capito, Ranking Member Carper, and other distinguished members of the Clean Air and Nuclear Safety Subcommittee of the Committee on the Environment and Public Works:

Good morning. My name is Edwin Lyman. I am a senior scientist in the Global Security Program at the Union of Concerned Scientists. On behalf of the Union of Concerned Scientists, I greatly appreciate the opportunity to provide testimony on the important subject of nuclear energy innovation and the critical role of effective regulation to ensure nuclear safety and security.

The Union of Concerned Scientists (UCS) puts rigorous, independent science to work to solve our planet's most pressing problems. UCS is neither pro- nor anti- nuclear power. We are a nuclear safety watchdog and work to ensure that U.S. nuclear reactors are adequately safe from accidents and secure from terrorist attacks.

Our position on nuclear power is not ideological but pragmatic. UCS believes that nuclear power could have a role to play in helping to mitigate the threat of climate change, and that the United States may need to extend the life of existing reactors and/or build new ones to address this problem. But this should only happen if nuclear power is sufficiently safe and secure. This means that any growth in nuclear power must be accompanied by increases in reactor safety and security; otherwise, the total risk to public health and the environment will increase.

Moreover, nuclear power could take itself out of the running if there is another event like the March 2011 Fukushima Daiichi nuclear plant disaster, whether caused by an accident or by a terrorist attack. Just over five years ago, Japan was a world leader in nuclear energy, with over

50 operating nuclear power reactors and bold plans to build many more. But Japan's nuclear establishment was too complacent about the dangers their reactors faced. Today, only two of those reactors are running and a battle is raging in the courts over the restart of two others. Japan's nuclear energy capacity is not likely to return to its pre-Fukushima level for many decades, if ever. The United States needs to do everything it can to avoid repeating Japan's mistakes. Therefore, Congress must ensure that the Nuclear Regulatory Commission (NRC) serves as a thorough and rigorously independent regulator for overseeing both the operation of existing plants and the licensing of new ones.

While the most efficient and cost-effective way to enhance reactor safety and security in the near-term is making evolutionary improvements in current designs and strengthening regulatory oversight, new and novel reactor technologies have the potential to achieve these goals in the longer term. However, experience has shown that there are no quick or easy fixes to make nuclear power safer. Although each new reactor type has advocates who make claims about the benefits of their preferred designs for improving safety, proliferation resistance or economic competitiveness, such assertions rarely stand up to scrutiny. Those who are engaged in the complex business of nuclear reactor development usually learn this lesson quickly. For example, the "traveling wave" concept that was a major early selling point of Bill Gates' Terrapower reactor—one of a class of reactors that UCS believes shows great promise—turned out not to work, necessitating a significant change in design.

Given the proliferation of new reactor designs and the massive investment needed to commercialize just one of them, private and public investment in nuclear development should be

focused on those concepts that have the greatest chance of meeting goals for enhanced safety, security, proliferation resistance, and economic viability. Cutting through the hype and identifying the best prospects is a major challenge. For this reason, a thorough and independent technical peer review process needs to be part of any government program that provides support to new nuclear projects, whether at the national labs or in the private sector.

Now I would like to focus my remarks on the matter at hand: S.2795, the Nuclear Energy Innovation and Modernization Act. Fundamentally, UCS believes that the NRC's regulations and procedures governing both operating plants and new plants are too weak to achieve the level of safety and security needed to ensure the viability of nuclear energy in the future. UCS does not agree with the notion that the NRC's licensing processes for advanced reactors are too stringent and need to be loosened to facilitate deployment of advanced reactors.

Some argue that the NRC's regulations impede U.S. competitiveness in the new nuclear power arena, allowing other countries like China to get ahead of us. We think the opposite is true: the reputation of the NRC for rigorous safety reviews only enhances the U.S. brand. We don't think that it would be wise for the United States to engage in a regulatory race to the bottom with China, which is mired in a Wild West-era of industrial development and is plagued by environmental catastrophes such as the 2015 warehouse explosions in Tianjin. U.S. companies should also appreciate the safety benefits of NRC scrutiny of nuclear power test and demonstration projects and resist the temptation to avoid it by out-sourcing such work to countries like China.

We believe that the focus of this bill on NRC licensing is misplaced and will do little to facilitate the deployment of advanced reactors in the United States. The NRC licensing process may be a convenient target, but we think the NRC is being scapegoated for the far more formidable institutional barriers that inhibit progress in advanced reactor development. These barriers include a lack of support for government-funded energy R&D in general and nuclear energy in particular; the enormously high cost (tens of billions of dollars) and long time needed (many decades) for bringing an advanced reactor project from design to commercialization; the lack of utility interest in investing in advanced reactor technology, especially in the face of the current electricity market climate; and the failure of nuclear power entrepreneurs to put their money where their mouths are and commit the resources necessary for seeing a project through to the end. We have seen no convincing evidence that the NRC licensing process is a significant factor in inhibiting advanced reactor deployment.

The history of the failed Next Generation Nuclear Plant (NGNP) project, a high-temperature gas-cooled reactor concept, is an illustrative example. The Energy Policy Act of 2005 mandated that the NRC and the DOE develop a licensing strategy for a prototype reactor within three years, address the differences between the gas-cooled reactor design and the NRC's light-water reactor-focused regulations, and set a 2021 target date for commencement of reactor operation. The NRC-DOE report, submitted to Congress in 2008, concluded that a "risk-informed, performance-based technical approach" (along the lines of what S.2795 proposes) would be the best way to establish a licensing basis for the reactor. The NRC began to engage with the DOE in developing such a licensing basis. Yet the project was suspended in 2011, not because of any licensing issues, but because the DOE was unable to find a single industry partner willing to accept at least

50 percent of the risk by participating in a cost-sharing arrangement, as required by the 2005 Energy Policy Act. (In spite of this, the NRC continued to work on issues related to licensing the reactor although it was clear no license application would be forthcoming.)

In its letter to then-DOE Secretary of Energy Steven Chu recommending suspension of the project, the DOE Nuclear Energy Advisory Committee cited the fact that "the current reluctance of vendors, owner-operator, and customers to commit to substantial up-front cost sharing in the NGNP development is unlikely to change in the near term."[1] The advisory committee also pointed out that other conditions worked against the project, including "short-term natural gas prices, a failure to internalize the social cost of carbon emissions, and the perceived high initial capital cost of the first few reactor plants deployed."

Thus, UCS does not believe the NRC's licensing procedures are the problem. The main problem is the cost and difficulty of obtaining the necessary analyses and experimental data to satisfy regulatory requirements and ensure that new reactors can operate safely. This is a fundamental issue we think Congress needs to address through oversight of the budget for nuclear energy R&D.

It is not clear that the fundamental changes to the current regulatory framework mandated by S.2795 would even help to accelerate the approval and deployment of advanced reactors. If the regulations themselves are changed to become less prescriptive, then more work on the part of applicants will be needed to demonstrate compliance, because the applications themselves will

[1] Nuclear Energy Advisory Committee, Department of Energy. *Readiness Review of NGNP to Proceed to Phase II of the Project.* letter to Energy Secretary Steven Chu. June 30, 2011.

need to translate the requirements into terms applicable to their own technology. Even if the rules are "technology-inclusive" (otherwise called "technology-neutral"), the applications of course will be technology-specific, and the NRC staff will require technology-specific expertise in order to review the applications. (This point was made very well in an April 14, 2016 post on the Energy Collective blog by scholars from Carnegie-Mellon University and University of California, San Diego.[2])

S. 2795 also calls for the NRC to establish a plan for a staged licensing structure of commercial advanced nuclear reactors. The bill itself is quite vague on what such a structure would look like, so it is hard to assess the benefits and risks of such an approach. However, we caution that dividing up a license application approval into stages may not lead to the increase in predictability of the process that the bill presumes would result. Leaving safety issues partially unresolved at early stages may only cause more problems at later stages, where resolution can be more troublesome, costly and time-consuming. For instance, approval of construction based on an incomplete design will likely lead to issues during construction that will require retrofitting and cause delays, or even worse, safety concerns during operation. For this reason, the nuclear industry is now striving to have substantially complete facility designs in hand before commencing construction.

We note that past attempts by Congress to legislate regulatory streamlining for new reactors—most notably "one-step" licensing—have not worked out as envisioned, leading some new reactor applicants to reconsider using the older, two-step procedures instead. And in fact, the

[2] Parth Vaishnavand Ahmed Abdulla, "The Myth of Technology-Neutral Regulation." Online at http://www.theenergycollective.com/parth-vaishnav/2376107/the-myth-of-technology-neutral-regulation.

one-step licensing approach seems to be at odds with the staged licensing process that this bill now proposes.

While S.2795 may not have significant benefits, it could impose an unfair burden on taxpayers. For example, the proliferation of new reactor designs has caused a problem for the NRC since many prospective new reactor vendors seek design certifications from the agency in order to obtain a stamp of approval that they hope to use to attract domestic and foreign customers. However, even with funding provided through user fees, the NRC does not have the staff resources—in terms of numbers or expertise—to certify designs that do not already have any committed end users. As a result, the NRC has a policy of generally limiting licensing reviews to vendors that have a utility partner. The changes mandated by S.2795 could result in the frivolous use of taxpayer resources to support licensing activities that are de-facto marketing exercises.

Moreover, the changes mandated by the legislation could put Americans at increased risk. For instance, requiring the NRC to introduce so-called "risk-informed, performance-based" licensing for advanced reactors could lead to less rigorous standards for approval of novel and untested technologies. These terms are ill-defined and should not be enshrined in statute. Moreover, UCS has many concerns with the way the NRC carries out "risk-informed" activities with regard to existing reactors, including an undue reliance on the results of risk studies based on paper analyses and computer models. These risk assessments are riddled with uncertainties, even for reactor types with decades of operational experience that provide copious quantities of data to validate the models. Relying on poorly validated theoretical models for licensing new reactors would be even more problematic. Thus, licensing of advanced reactors should not use potentially

inaccurate risk information, but should wait until operating experience with new technologies provides adequate information on demonstrated performance.

The research and development needed to commercialize any novel advanced reactor design is painstaking and requires great patience. Qualifying a new type of reactor fuel alone can take decades, given the time needed to conduct the necessary irradiation testing and post-irradiation examination. The process cannot be rushed without compromising safety. And the licensing process must be comparably diligent. We have seen no evidence that NRC staff are nitpicking and causing unnecessary delays in reactor licensing approvals. By and large, they are just trying to do their jobs and fulfill their responsibilities to keep the American public safe and secure.

In sum, it is not at all clear that the current licensing process for advanced reactors is a hindrance to their deployment, and even if it were, the highly complex and bureaucratic staged licensing process outlined in S.2795 may not be the right way to proceed.

Consequently, UCS believes that it is premature for Congress to prescribe a way forward until there is an independent review of these questions. UCS encourages Congress to first commission a National Academy of Sciences study to identify all the systemic obstacles to licensing and deployment of advanced reactors. This would encompass a range of issues, including selection processes for promising concepts; vendor financing and government subsidies; utility commitment and investment; gaps in the R&D infrastructure needed to address safety issues of novel designs; the role of prototypes (who should pay for them and how they should be licensed); and the critical issue of how the NRC can obtain the necessary expertise on staff in

order to license new reactor designs in a timely way without wasting resources on hiring and training experts in technologies that may not pan out. (Although S.2795 requires the NRC to develop a plan to enhance expertise, we think that solving this problem will require broader government engagement.) Such a study could provide useful insights as to where the real bottlenecks are and help guide congressional action. The study should also review whether the current licensing framework poses impediments to advanced reactor deployment, and if so, whether the processes outlined in S.2795 would be effective and efficient. A three-year study would still provide plenty of time for the NRC to implement regulatory reforms by 2025, should the report indicate a need for such reforms.

Moreover, UCS believes that comprehensive legislation to strengthen safety and security of both operating reactors and new reactors is needed, and we would welcome the opportunity to work with Congress to craft such a bill. There are numerous issues of concern to us that are not addressed in S.2795.

For example, one of the major problems with NRC's approach to advanced reactors, as articulated in the NRC's Advanced Reactor Policy Statement, is that it does not *require* new reactors to be safer than existing reactors. UCS believes that this policy inhibits true innovation in reactor design that could lead to significantly safer nuclear power in the future. For instance, the NRC recently rejected a staff proposal that new reactors should be designed to be more robust than operating reactors, and to rely less on portable emergency equipment, in the event of a Fukushima-like station blackout.[3] Legislation to mandate that new reactors be safer and more

[3] U.S. Nuclear Regulatory Commission. Staff requirements – SECY-15-0065 – Proposed rulemaking: mitigation of beyond-design-basis events. August 27, 2015.

secure than operating reactors could help to build confidence in the enduring safety of next-generation reactors in the United States.

Below we address additional specific aspects of S.2795.

User fee provisions (Sections 5 and 6). S.2795 would substantially revise the user fee schedules for NRC activities. We have concerns about the potential impact of these revisions on the ability of the NRC to carry out its statutory responsibilities to protect public health and safety.

In general, UCS opposes exempting advanced reactor licensing activities from user fee recovery. If further government subsidies for new reactor licensing activities are determined to be appropriate by Congress, mechanisms such as providing funding through the DOE "advanced nuclear energy licensing cost share grant program" proposed in Section 9 could be used rather than altering the existing user fee structure. This would be a more transparent and predictable approach in that the expenditure of resources would be clearly aligned with specific projects.

UCS also opposes the blanket cap on annual fees for operating reactor licensees proposed in Section 6. The justification for this cap and its relationship to the stated purpose of the bill to "modernize the regulation of nuclear energy" is unclear. We believe that NRC funding must retain a measure of flexibility to allow the agency to respond in a timely way to emerging and potentially serious safety and security problems. The waiver provision does not appear to provide

sufficient relief because it introduces uncertainty into the NRC's budgeting process that could hamper its planning and regulatory effectiveness.

UCS also notes that the bill would increase reporting requirements for various NRC tasks while also restricting the funding for such administrative activities (corporate support costs). This has the potential to put additional burdens on the NRC's staff time and resources that could be better spent directly on safety and security activities.

Elimination of the NRC mandatory hearing requirement (Section 8). UCS opposes this provision. Mandatory hearings provide an important independent review of uncontested issues addressed in new reactor license approvals and allow the Atomic Safety and Licensing Board (or the NRC commissioners themselves) to examine the adequacy of the NRC staff's review of license applications. Diane Curran, a lawyer, has identified numerous examples from past mandatory hearings in which serious deficiencies in the NRC staff's review were uncovered. These issues would not have come to light in the absence of mandatory hearings. This process helps to provide public confidence that all technical issues have been thoroughly and adequately considered by the NRC.

In conclusion, the future of nuclear power depends crucially on the NRC's credibility as an effective and thorough regulator. Congress should reject any attempt to short-circuit the NRC's safety reviews for either operating or new reactors, and instead help ensure that the reactor

oversight and licensing process will result in clear improvements in safe and secure operation.

Thank you for your attention.

BIOGRAPHY

Edwin Lyman is a senior scientist at the Union of Concerned Scientists in Washington, DC. He earned a doctorate in physics from Cornell University in 1992. From 1992 to 1995, he was a postdoctoral research associate at Princeton University's Center for Energy and Environmental Studies (now the Science and Global Security Program). His research focuses on the prevention of nuclear proliferation, nuclear and radiological terrorism, and nuclear accidents. He has published articles and letters in journals and magazines including *Science*, *Nature*, *The Bulletin of the Atomic Scientists*, *Science and Global Security*, *Arms Control Today*, *Nuclear Engineering International* and *Energy and Environmental Science*. He is a co-author (with David Lochbaum and Susan Q. Stranahan) of the book *Fukushima: The Story of a Nuclear Disaster* (The New Press, 2014).