INVIGORATED FEDERAL INTEREST IN FUSION ENERGY PRESENTS OPPORTUNITIES AND QUESTIONS FOR GROWING PRIVATE FUSION ENERGY SECTOR

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Significant investment is flowing into private companies seeking long-sought-after breakthroughs to develop practical power generation solutions based on nuclear fusion reactions. [1] Fusion reactions have become relatively commonplace in the laboratory setting, but no one has developed a nuclear fusion reactor yet that produces more energy than the device uses to operate and maintain the reaction. Numerous private companies, in the United States and around the world, are attacking this challenge with a variety of approaches, with the goal of making the technology sustainable, practical, and commercial. These companies are receiving significant investment from backers who believe a solution is within reach.

The U.S. Congress and the executive agencies (like the Department of Energy) have shown that they remain committed to developing the underpinnings of a more complete fusion energy ecosystem. Indeed, they may even be more interested in fusion energy now than in years past. For example, Congress's latest appropriations legislation increases funding for fusion energy science at the Department of Energy (“DOE”) and increased funding for the United States' contribution to the International Thermonuclear Experimental Reactor (“ITER”) under construction in France. Other recent legislation has directed DOE and other agencies to take a more active role in understanding fusion energy issues.

But many questions remain unresolved regarding the government's role in regulating fusion energy systems. Which agency will regulate fusion energy activities? What should those regulations cover? What should the regulatory philosophy be? These open questions present opportunities for the growing fusion business community to present their views to policymakers and regulators, allowing private-sector stakeholders to help shape a regulatory framework that promotes safe operations and efficient deployment of the technology when commercial fusion reactors transition from the laboratory to the power grid.

STATE OF FUSION REGULATION

Although the United States does not have a comprehensive regulatory program for commercial fusion reactors, current law contemplates the potential for regulating fusion energy devices. Section 11 of the Atomic Energy Act (“AEA”) provides authority to the Nuclear Regulatory Commission (“NRC”) to regulate “utilization facilities” that use “atomic energy” when those facilities' atomic energy use implicates “significance to the common defense and security or … affect the health and safety of the public.” [2] The AEA defines “atomic energy” as “all forms of energy released in the course of nuclear fission or nuclear transformation.” [3] Legislative history accompanying

the 1954 amendment to the AEA indicates that Congress may have intended the phrase “nuclear transformation” to include fusion reactors. [4] Under the terms of the AEA, NRC must assert its jurisdiction via a federal rulemaking procedure.

In response to inquiries from early movers in the private fusion sector, NRC evaluated the state of fusion regulation. An April 2009 memorandum from NRC staff considered the question and recommended that NRC assert jurisdiction over commercial fusion devices and that NRC staff monitor developments in the space. [5] The NRC staff memorandum recognized that the AEA requires that NRC make a rulemaking to establish jurisdiction over commercial fusion energy devices. [6] NRC agreed and adopted its staff's recommended approach in July 2009, stating that the agency “asserts, as a general matter, that the NRC has regulatory jurisdiction over commercial fusion energy devices whenever such devices are of significance to the common defense and security, or could affect the health and safety of the public.” While the staff recommended “conducting further evaluations of the technical and legal issues associated with the regulation of specific fusion devices and providing more detailed recommendations to the Commission,” NRC's Commissioners cautioned against expending significant resources to develop a regulatory framework for fusion until commercial deployment is “more predictable” or “much nearer at hand.” [7]

Presumably because it considers commercial fusion energy to remain less predictable and not close at hand, NRC has not taken further public steps toward developing a national regulatory framework that would apply to commercial fusion energy systems or toward initiating a rulemaking to establish explicit jurisdiction over commercial fusion energy devices.

INCREASED FEDERAL INTEREST IN FUSION ENERGY

Although NRC has not moved forward on developing a regulatory framework for fusion, DOE and Congress remain focused on fusion energy research and development. DOE's Office of Science has managed federal research efforts, in concert with various national laboratories, for many years for magnetic confinement and inertial confinement fusion approaches. [8] DOE's Fusion Energy Science initiative also disburses funding for fusion energy research [9] and manages the efforts of the Fusion Energy Sciences Advisory Committee (“FESAC”). [10]

Likewise, the United States Congress has continued to support fusion energy research, increasing appropriations for Fiscal Year 2019 to support fusion energy science, high energy plasma, and the United States' contribution to ITER. [11] Congress also boosted support for ARPA-E, [12] which supports fusion research and development via the “ALPHA” program. [13] And Congress has directed FESAC to work with DOE to “review establishing a reactor concepts research, development and deployment activity. [14]

In addition to appropriating federal funds, Congress has directed DOE to take a more active role in encouraging commercialization of advanced nuclear reactor technologies, including fusion energy. Passed by Congress and signed by President Trump on September 28, 2018, the Nuclear Energy Innovation Capabilities Act of 2017 mandates that DOE assist in the development of civilian nuclear research for eventual commercial application. The statute includes “nuclear fusion reactors” within the definition of “advanced nuclear reactors” that DOE should support. [15] According to this new law, DOE and NRC must enter into a memorandum of understanding that allows:

- DOE to gain “sufficient technical expertise to support the timely research, development, demonstration, and commercial application by the civilian nuclear industry of safe and innovative advanced nuclear reactor technology” and
- NRC to build “sufficient technical expertise to support the evaluation of applications for licenses, permits, and design certifications and other requests for regulatory approval for advanced nuclear reactors. [16]

Through this memorandum of understanding, the statute establishes the mechanism for NRC to solidify the expertise it needs to develop a regulatory framework for advanced nuclear reactors, including nuclear fusion reactors. The statute does not require that NRC develop a regulatory framework that would apply to commercial fusion devices at this time. Instead, the statute lays out an avenue for NRC to develop expertise on fusion energy and other advanced nuclear reactor technologies. The statute also directs DOE to establish a cost sharing grant program that would cover a portion of the fees associated with NRC's pre-application and application review activities. [17] Congress also requests a report within six months outlining “engineering designs for innovative fusion energy systems that have the potential to demonstrate net energy production not later than 15 years after the start of construction.” [18]

Congress has taken further action with the Department of Energy Research and Innovation Act, also signed into law on September 28, 2018. [19] Section 307 of this new statute directs DOE to support research and development for tokamaks [20] and inertial confinement fusion energy approaches, [21] as well as “alternative and enabling concepts” that may provide “solutions to significant challenges” to achieving commercial fusion power. The statute also requires DOE to coordinate with ARPA-E and to develop a 10-year plan for fusion energy research and development activities.

NEXT STEPS AND OPPORTUNITIES

Given Congress's mandates, the Trump administration's efforts to accelerate commercial development of fusion technologies, and recent high-profile investments in fusion start-up companies, [22] there are opportunities to shape how the federal government will approach the regulation of fusion energy systems and how fusion energy companies will interact with regulators. In addition to providing funding, Congress is seeking a path to build a fusion energy ecosystem, with full participation by the private sector. Congress has asked for input as to how it should direct its funding in the coming years, signaling its openness to suggestions for future appropriations.

These recent actions indicate that DOE and NRC are moving into a more active phase of involvement in the fusion energy space through the memorandum of understanding process to allow both agencies to understand the needs and goals of commercial fusion developers. The agencies' interests present opportunities for the private fusion energy sector to engage with and shape policymakers' approaches to fusion in the years to come.

In order to take advantage of these opportunities, the fusion industry should clarify its ideal government support and regulatory environment and present these optimal conditions to policymakers for implementation. Private stakeholders should work together to solidify their policy requests to Congress and the executive agencies, clarifying what the private fusion community wants, what it does not want, and how to best implement these goals. Stakeholders in the fusion sector should take advantage of policymakers' current focus on fusion energy topics to demonstrate the value proposition of commercial fusion for the U.S. energy portfolio and for U.S. leadership in this critical field of technology.

Notes:

[1] For the purposes of this non-technical analysis, “fusion energy” refers to energy released upon the fusing of two relatively light atomic nuclei. There are two technical approaches to maintaining a nuclear fusion reaction: magnetic confinement and inertial confinement. DOE has explained the differences between the two approaches. DEP'T OF ENERGY OFFICE OF SCIENCE, About Fusions and Plasmas, https://science.energy.gov/fes/about/fusion-and-plasmas/.

[2] 42 U.S.C. § 2014(cc).

[3] 42 U.S.C. § 2014(c).

[4] S. Rpt. No. 1699 at 11. See also id. at 8 (explaining that Congress changed the phrase “fissionable material” to “special nuclear material” in order to apply the provision to materials that parties use in fusion processes).

[5] R. W. Borchardt, NRC Memorandum, SECY-09-0064, https://www.nrc.gov/reading-rm/doc-collections/commission/secys/2009/secy2009-0064/2009-0064scy.pdf (Apr. 20, 2009).

[6] Id. at 3.

[7] Annette L. Vietti-Cook, NRC Memorandum on Commission Voting Record for SECY-09-0064, https://www.nrc.gov/reading-rm/doc-collections/commission/srm/2009/2009-0064srm.pdf (Jul. 16, 2009), Comments of Commissioners Dale Klein and Kristine Svinicki.

[8] DEP'T OF ENERGY OFFICE OF SCIENCE, Fusion Energy Sciences, https://science.energy.gov/fes/.

[9] DEP'T OF ENERGY OFFICE OF SCIENCE, Fusion Energy Sciences Funding Opportunities, https://science.energy.gov/fes/funding-opportunities/.

[10] DEP'T OF ENERGY OFFICE OF SCIENCE, Fusion Energy Sciences Advisory Committee, https://science.energy.gov/fes/fesac/.

[11] H.R. 5895, Energy and Water Appropriations at 13, https://www.congress.gov/115/bills/hr5895/BILLS-115hr5895enr.pdf.

[12] Id.

[13] ADVANCED RESEARCH PROJECTS AGENCY - ENERGY, ALPHA PROGRAM, https://arpa-e.energy.gov/?q=arpa-e-programs/alpha.

[14] Conference Report to Accompany H.R. 5895 at 162, https://www.congress.gov/congressional-report/115th-congress/house-report/929/1?overview=closed.

[15] Nuclear Energy Innovation Capabilities Act of 2017 § 2(a), https://www.congress.gov/bill/115th-congress/senate-bill/97/text?q=%7B%22search%22%3A%5B%22s97%22%5D%7D&r=1. The statute does not define the term “nuclear fusion” or “nuclear fusion reactor,” but other federal laws define “fusion” in other contexts. See, e.g., Magnetic Fusion Energy Engineering Act of 1980 § 3, 42 U.S.C. § 9302(1) (“'[F]usion' means a process whereby two light nuclei, such as deuterium and tritium, collide at high velocity, forming a compound nucleus, which subsequently separates into constituents which are different from the original colliding nuclei, and which carry away the accompanying energy release”).

[16] Nuclear Energy Innovation Capabilities Act of 2017 § 2(h), https://www.congress.gov/bill/115th-congress/senate-bill/97/text?q=%7B%22search%22%3A%5B%22s97%22%5D%7D&r=1.

[17] Nuclear Energy Innovation Capabilities Act of 2017 § 3, https://www.congress.gov/bill/115th-congress/senate-bill/97/text?q=%7B%22search%22%3A%5B%22s97%22%5D%7D&r=1.

[18] Id. at §2(j).

[19] Department of Energy Research and Innovation Act, https://www.congress.gov/bill/115th-congress/house-bill/589/text?q=%7B%22search%22%3A%5B%22hr589%22%5D%7D&r=1.

[20] A “tokamak” is a fusion device design that uses magnetic containment. CULHAM CENTRE FOR FUSION ENERGY, The Tokamak, http://www.ccfe.ac.uk/Tokamak.aspx.
[21] "Inertial confinement fusion” refers to devices that direct powerful lasers at small pellets of fuel, often isotopes of hydrogen, to initiate a fusion reaction. LAWRENCE LIVERMORE NATIONAL LABORATORY, Inertial Confinement Fusion: How to Make a Star, https://lasers.llnl.gov/science/icf.
[22] Akshat Rathi, In Search of Clean Energy, Investments in Nuclear-Fusion Startups Are Heating Up, QUARTZ, https://qz.com/1402282/in-search-of-clean-energy-investments-in-nuclear-fusion-startups-are-heating-up/

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