A Reactor Baby Boom

By John Benson

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1. Introduction

A recent news-article that I posted reminded me that a have written many papers on Nuclear Reactors (of all sorts). Then I immediately read an article about this subject that I found very interesting. Hopefully, so will my readers as it the subject of this paper.

2. Baby Reactors

A little over a year ago, President Trump set an ambitious goal: He wanted to see American companies build at least three new experimental nuclear reactors by July 4, 2026, the 250th anniversary of the Declaration of Independence.[1]

Shortly after Trump signed an executive order enshrining his goal, the Department of Energy launched its Reactor Pilot Program. The program is designed to help companies build and run test reactors quickly, in part by radically cutting back on the regulations required for such reactors.

That program has sparked a nuclear race, and with less than a week to go, two companies have already reached the goal of switching on their reactor ("going critical" in nuclear-speak).

On June 4, Antares Nuclear announced it had gone critical, and Valar Atomics said it went critical on June 18 and is now producing tens of kilowatts of heat from its new reactor core, which is operating out of a tentlike structure in the Utah desert.

Other companies are getting close to making the deadline, and all this happened in less than the span of a year.

"We haven't done anything this fast, basically ever," said Nick Touran, chief nuclear officer at Ocean Atomics, which seeks to put nuclear power onto civilian ships. His company isn't part of this program, but he has been tracking it closely.

He says this pilot program could jump-start America's nuclear industry.

"I'm just excited that we're now actually building these little reactors and trying it out and we're going to look at what the economic story is and find out if there's a market," he said. "It's going to be so much better than sitting there talking about it like we did for the last 40 years."

2.1. Too Fast?

But for others, the speed sparks alarm. The race is "essentially an exercise in public relations," said Edwin Lyman, director of nuclear power safety at the Union of Concerned Scientists. And, he added, the slashing of regulations undoes decades of safety lessons learned in the nuclear industry.

[1] Geoff Brumfiel, KQED, "Red, white and glowing blue: Trump's push for new reactors reaches the finish line," June 29, 2026, https://www.npr.org/2026/06/29/nx-s1-5847944/new-nuclear-reactors-america-250-safety-concerns

Author's comment: Although I respect the Union of Concerned Scientists, I also recognize their risk-tolerance is too low. If Humanity never took risks, we would still be living in caves. Since I've worked in the nuclear industry for about a decade early in my career, I know their focus on safety is extremely robust. I left my last job in the Nuclear Industry (at GE's Vallecitos Nuclear Center aka VNC)[2] in 1977. However, for the last 40 years I have lived in a house just over hill north of this facility (in Livermore, CA) and never felt threatened. This facility, including nuclear hot-cells and three old reactors is currently being taken "back-to-grass" (completely decommissioned and any residual radiation removed). Since the area around VNC is primarily ranchland (grazing for cattle and horses), I expect that is what VNC will become after it's taken back-to-grass.

3. A New Beginning

A lot of the action is happening at the Department of Energy's Idaho National Laboratory, where several of the companies have set up shop. One of them is Radiant, which hopes to build small reactors for everything from disaster relief to data centers. Rita Baranwal, the firm's chief nuclear officer, said they are assembling their reactor inside a special secure building called the DOME.

"By July 4, we're tracking to get the reactor into DOME and to initiate the testing," she told NPR this month.

Initiating testing isn't quite the same as going critical, and Baranwal said Radiant probably won't be critical by the July 4 deadline. But she does expect that Radiant's reactor will be running soon. "The only thing we will not be doing at [Idaho National Laboratory] this summer is generating electricity," she said.

Radiant's reactor looks radically different from the massive reactors that exist today. It's far smaller, and its nuclear fuel takes a different form. In a modern power reactor, nuclear fuel is loaded into long tubes, but Radiant's reactor uses little nuclear fuel balls filled with grains of uranium. "Do you remember gobstoppers?" Baranwal said.

These nuclear gobstoppers can operate at higher temperatures and are more resistant to melting down. Radiant and several other companies plan on using this type of fuel along with other tech to build a bunch of smaller, more mobile reactors.

"We have broken ground on our factory to mass-produce reactors. We're targeting around 50 per year," she said. (Currently, 96 reactors are operating in the United States.)

To get the reactors built this quickly comes at a cost. This year, NPR reported that the Energy Department completely rewrote its safety and security standards to make it easier for companies to win regulatory approval. The department has said that the cut regulations were "unnecessary" and that safety hasn't been compromised.

Author's comment: I agree with the "unnecessary" assessment in the prior paragraph. It is silly to use the same safety standards for a 1,000 Megawatt commercial power reactor as you do for small modular reactor (SMR) or a microreactor. An SMR has an energy output of 70 to 350 MW and a microreactor has an output of 1-20 MW. A commercial power reactor generally has a lifetime of 50-years to a century. An SMR will have a life in the range of ten to twenty years, and a microreactor may have a much shorter lifetime. See section 3.1.4 and the figure therein for more information.

[2] Vallecitos Nuclear Center, https://en.wikipedia.org/wiki/Vallecitos_Nuclear_Center

After an SMR or microreactor is decommissioned, it will probably be moved (en masse) to a nearby secure location to allow it's short-half-life radioactive isotopes to decay and make transport to a medium-radioactive waste storage-facility more economical. I wouldn't worry too much about security: even though the most active radioactive isotopes will decay, the reactor will still be deadly-radioactive, and will quickly disable any potential hijackers in close proximity. The "…more economical…" will be because they will require significantly less (really-heavy) concrete and steel shielding and can be transported by normal simi-trucks.

The department consulted with the companies but not with the public. It also exempted the new reactors from environmental reviews.[1]

And that has some skeptics of the program worried.

"Yes, of course, if you bend all the rules, you can do things quickly," said Lyman, referring to the Energy Department's decision to rewrite its rules for the program.

"The test reactors might be working," he said, "but that should not be confused with anything related to a nuclear power reactor that's capable of producing electricity in a stable and safe way."

3.1. SMR Development

The U.S. is advancing small modular reactors (SMRs) with ongoing projects like Project Pele, and increasing industry interest, aiming for deployment in the 2030s.

3.1.1. U.S. Department of Energy Funding

The U.S. Department of Energy (DOE) has allocated $900 million to support the development of small modular reactors (SMRs). This funding aims to transition SMRs from design to operational status, focusing on advanced Generation III+ reactors that utilize light water as coolant and low-enriched uranium as fuel. The initiative encourages projects that are reliable, licensable, and commercially viable, with a goal of having these reactors ready for deployment in the 2030s

3.1.2. Project Updates and Collaborations

Project Pele: *The fabrication of the reactor core for the Project Pele prototype mobile microreactor has begun in Virginia. This project is notable as it represents the first microreactor to be built and operated in the U.S.*

Industry Collaborations: *Companies like Oklo Inc. are partnering with critical infrastructure providers to develop advanced power solutions tailored for data centers, powered by their advanced nuclear plants. Additionally, BWX Technologies has made significant progress in producing specialized fuel for advanced reactors*

3.1.3. Growing Interest and Global Context

The OECD[3] *Nuclear Energy Agency's latest report indicates a growing global interest in SMRs, with 51 designs currently in pre-licensing or licensing processes. This reflects a significant increase in funding commitments and active discussions between developers*

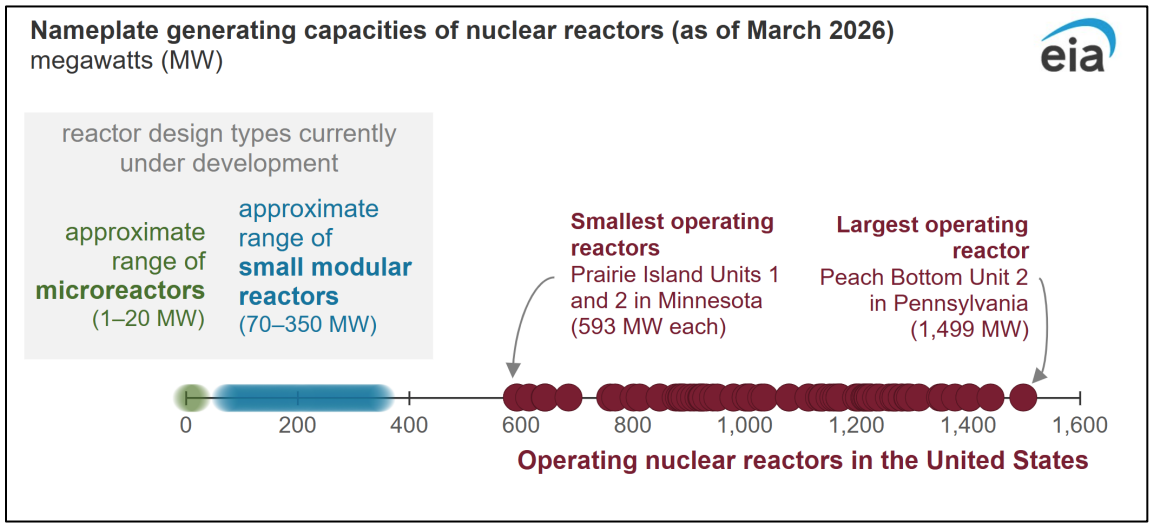
The report emphasizes that SMRs are becoming integral to energy strategies worldwide, driven by rising electricity demand and the need for reliable, low-carbon energy sources.

[3] Organization for Economic Co-operation and Development

Challenges and Future Outlook: Despite the advancements, the path to deploying SMRs in the U.S. remains fraught with challenges, including regulatory hurdles and the need for substantial investment. The DOE's renewed push for SMRs is seen as a critical test to determine whether these reactors can overcome longstanding barriers and become a viable solution for the future of nuclear energy in the U.S.

In summary, the landscape for small modular reactors in the U.S. is evolving, with significant government support, ongoing projects, and a broader acceptance of nuclear power as a key player in the transition to cleaner energy sources.

3.1.4. Timeline for SMR Development



Data source: U.S. Energy Information Administration, Monthly Nuclear Utility Generation by State and Reactor

3.1.5. SMR & Microreactor Applications

Aside from providing electricity to a power grid, SMRs and microreactors could provide power for applications where large plants are not needed or for sites that lack the infrastructure to support a large unit. SMRs are under consideration for powering AI, data centers, or other industrial activities where developers may not want or need to connect to the grid. SMRs could also service remote areas and communities that have high transmission and distribution costs.

SMR designs may employ light water as a coolant or other non-light water coolants such as gas, liquid metal, or molten salt. Several designs use high-assay low-enriched uranium (HALEU) fuel, which is uranium enriched with between 5% and under 20% uranium-235, the main isotope that produces energy. HALEU is more highly enriched than the sub 5% low-enriched uranium (LEU) fuel currently used in most nuclear reactors. The higher enrichment has a faster burnup, which could improve efficiency and performance, allow smaller reactor footprints, and reduce spent fuel waste.

3.1.6. Government Support

Federal government support for domestic SMR technology has increased. In March 2025, U.S. Department of Energy (DOE) reissued a tender for $900 million in federal funding to promote SMR development. In June 2025 DOE announced the Energy Reactor Pilot Program. The program aims to expedite the testing of advanced reactor designs authorized by the Department at sites that are located outside of the national laboratories. Applicants are responsible for funding their individual pilot reactor designs, but the program is intended to support further private funding and provide a fast-track approach to licensing. DOE has selected the following vendors for the program: Aalo Atomics Inc.; Antares Nuclear, Inc.; Deep Fission Inc.; Last Energy Inc.; Oklo Inc.; Natura Resources LLC; Radiant Industries Inc.; Terrestrial Energy Inc.; and Valar Atomics Inc.

3.1.7. DOD Activity

The U.S. military is in the process of adopting commercial microreactors. In 2024, the Defense Innovation Unit with the Department of the Army and the Department of the Air Force launched the Advanced Nuclear Power for Installations program.

In April 2025, the following eligible vendors were named for the program: Antares Nuclear, Inc.; BWXT Advanced Technologies LLC; General Atomics Electromagnetic Systems; Kairos Power LLC; Oklo Inc.; Radiant Industries Inc.; Westinghouse Government Services; and X-Energy, LLC.

In October 2025, the Department of the Army announced the launch of the Janus Program, aimed at building microreactors. The Janus Program will build upon Project Pele -- a transportable nuclear reactor intended for electricity production. The Idaho National Laboratory (INL), which worked on Project Pele, will also be working on the Janus Program.[4]

As part of next steps for the Janus Program, the Department of the Army has selected nine bases to possibly site microreactors. These installations include Fort Benning, Fort Bragg, Fort Campbell, Fort Drum, Fort Hood, Fort Wainwright, Holston Army Ammunition Plant, Joint Base Lewis-McChord, and Redstone Arsenal.

The Department of the Air Force is planning its first nuclear microreactor at Eielson Air Force Base in Alaska, in a pilot program with Oklo, Inc., selected as the vendor for their sodium-cooled Aurora design reactor. The project will be commercially owned and operated and aims to deliver 1 MW to 5 MW of electricity by 2027.

The Department of the Navy has used advanced nuclear reactors to power aircraft carriers and submarines since the 1950s but is also soliciting offers for commercial on-site SMRs and microreactors to power its installations.

3.1.7.1. Additional Information on the Janus Program

The Janus Program will leverage the Army's nuclear regulatory authorities in close partnership with the Department of Energy to ensure the highest standards of safety, oversight, and transparency.[4]

[4] U.S. Army Public Affairs, "Army announces Janus Program for next-generation nuclear energy," Oct 14, 2025, https://www.army.mil/article/288903/army_announces_janus_program_for_next_generation_nuclear_energy

“Since the Manhattan Project, the Department of Energy and the Department of War have forged one of the defining partnerships in American history—advancing the science, engineering, and industrial capability that power our national security,” said Wright. “What began as a wartime effort became the backbone of America’s peacetime strength. Under President Trump’s leadership, we’re extending that legacy through initiatives like the Janus Program, accelerating next-generation reactor deployment and strengthening the nuclear foundations of American energy and defense.”

The program will build commercial microreactors through a nimble, milestone-based contracting model in partnership with the Defense Innovation Unit (DIU)[5], accelerating delivery of advanced energy solutions to the warfighter.

The reactors will be commercially owned-and-operated, with the milestone payments intended to help companies close their business cases as they seek “Nth-of-a-kind” production. The Army and DIU will be modeling this contracting mechanism off of NASA’s Commercial Orbital Transportation Services (COTS) program.

The Army will provide technical oversight and assistance, including support to the full uranium fuel cycle and broader nuclear supply chain, ensuring the program strengthens both defense and U.S. industrial capabilities.

[5] https://www.diu.mil/