US cost-sharing thrusts next-gen nuclear into construction phase

By Mark Shenk

U.S. federal support helped TerraPower and Kairos Power to start building full-sized demonstration advanced reactors in April, with X-energy set to follow suit next year

June 23 - The U.S. Department of Energy (DOE) launched the Advanced Reactor Demonstration Program (ARDP) in May 2020 with a $3.2 billion, seven-year budget to help domestic companies build commercial-scale reactors. The agency later selected three small modular reactor (SMR) developers for the initiative, which is now bearing fruit. Kairos broke ground on its Hermes 2 fluoride salt-cooled, high-temperature reactor in Oak Ridge, Tennessee on April 17, while TerraPower started building its 345 MW sodium-cooled Natrium plant in Kemmerer, Wyoming soon after.

X-energy, which raised $1 billion when it went public in April, expects to secure a construction permit by the first quarter of 2027 to build its first SMR for Dow Chemical in Texas. All three developers have signed off-take contracts. Under an agreement with Google, the Kairos Hermes 2 will produce 50 MW of clean electricity for the Tennessee Valley Authority (TVA) grid, while TerraPower has signed a deal with Meta for eight Natrium units, which will feature integrated molten salt–based heat storage systems that can temporarily boost output to 500 MW. X-energy plans to develop four 80 MW Xe-100 reactors in Texas for Dow Chemical. DOE's ARDP program provides up to 50% of the cost of the projects, as well as technical and regulatory assistance for design and licensing work. For example, under a cost-sharing agreement signed in 2021, DOE committed $1.2 billion for the X-energy project.

ARDP "was instrumental in the derisking and enabling of these projects," Adam Stein, director of nuclear energy innovation at the Breakthrough Institute, told Reuters Events. "It was a public private partnership that took the long view, which is necessary for starting a whole new industry and was intentionally patient about getting to completion instead of rushing through something," he added.

CHART: Small Modular Reactor projects by country

In the case of TerraPower's Natrium project, which has an estimated cost of $4 billion, the U.S.government will provide $2 billion. "The DOE's ARDP authorizes a 50/50 cost share, with TerraPower and our investors matching DOE's investment dollar for dollar," Eric Williams, Executive Vice President and Chief Operations Officer at

TerraPower, told Reuters Events. “If there was no public side of the funding, then the private side of the funding probably wouldn't have been there either,” Stein said. The Natrium plant, which TerraPower is developing alongside GE Hitachi Nuclear Energy, should be completed in 2030.

“ARDP is intended to validate the design, construction and operational features of the Natrium system, help speed new nuclear solutions to market by supporting first-of-a-kind challenges, and compete against [foreign] state-sponsored nuclear programs to demonstrate new technologies, ”Williams added. DOE in February 2024 agreed to provide Kairos with up to $303 million through ARDP to support the construction of Hermes 2, which is expected to be completed by 2030. “This performance-based investment supplements Kairos Power’s substantial private funding, helping the company to stand up extensive testing and [secure] manufacturing infrastructure that will be critical to enabling our early reactor deployments,” a Kairos spokesperson told Reuters. Under ARDP, developers receive incremental, fixed payments as they successfully complete predefined project milestones based on three baselines: technical, schedule, and cost-sharing.

“Kairos Power is only paid when we deliver. The award has proven to be a successful tool for driving significant technical progress with a relatively modest investment by the U.S. government,” the Kairos spokesperson said.

Construction challenge

The vast majority of commercial reactors in the U.S. are Generation II reactors, while Vogtle 3 and 4 in Georgia are the only Generation III+ reactors operating in the country. Vogtle 3 and 4, which became operational in 2023 and 2024, were completed seven years behind schedule, and costs more than doubled from the initial projection of $14 billion. TerraPower, Kairos, and X-energy are expected to face similar challenges. “Nuclear obviously has had a lot of trouble with coming in on time and on budget, so I think what these companies have to do with their first units or their early demonstrations is show some ability to control timelines and control cost,” said James Richards, Manager, Economics and Project Development Program at the Nuclear Innovation Alliance (NIA).

“You have so many stakeholders at the table that the project controls are going to have to be really tight, and you have to make sure that you're on top of these suppliers who themselves are doing new things,” Richards told Reuters Events.

For exclusive nuclear insights, sign up to our newsletter. The projects will face particular supply chain hurdles because they “use new materials and different methods of construction,” Madeline Cohn, Project Manager at the EFI Foundation, told Reuters

"They require new qualifications and different types of skills, so there are lots of unique challenges for some of these Gen IV designs to overcome as compared to light water reactors," Cohen told Reuters. But to mitigate deployment risks, the three reactor developers have partnered with highly experienced construction companies and project developers.

Bill Gates-backed TerraPower told Reuters Events earlier this year that it had secured 100% of its long-lead items for the Wyoming project following multiple procurement

rounds. In March the company signed a partnership with shipbuilding specialist HD Hyundai to scale the supply chain for its Natrium reactor, expanding a 2024 deal under which HD Hyundai will supply the reactor vessel for TerraPower's first Natrium plant.

"The team has been thinking strategically and working tirelessly to address many of the challenges that have plagued the nuclear industry for years," TerraPower's Williams said.

Kairos is building in-house manufacturing facilities at its sites in Albuquerque, New Mexico; Alameda, California; and Oak Ridge, Tennessee, for a significant proportion of its procurement. Its current in house capabilities include machining, welding, fabrication, additive manufacturing, water-jet precision cutting, graphite manufacturing and molten salt coolant production.

Its facility in Albuquerque will produce industrial quantities of high-purity molten salt coolant. The company is collaborating with BWXT, which has more than 20 years of operational experience in

TRISO (Tri-Structural Isotropic) nuclear fuel manufacturing, to scale up commercial production for its fleet, aiming to lower fuel costs for the industry. "We are addressing the domestic supply chain gap for enriched Lithium-7 by building a new Salt Production Facility at our Manufacturing Development Campus in New Mexico, which will have the capacity to supply enough Li-7 to meet the needs of the entire U.S. light-water reactor fleet," the Kairos spokesperson said.

The three companies had to work with the NRC to secure construction permits, and pass environmental, safety, and technical reviews.

"I know that folks in those companies, all three of them, worked hand in hand with the NRC to get through those construction permits," Richards said. "TerraPower engaged in a robust and rigorous review process with the NRC during the past four years —in both the pre-application and application review phases," TerraPower's Williams said, adding that the process involved more than 60 meetings with NRC staff, six white papers and 15 topical reports.

The licensing work for ARDP projects will likely help the whole industry, Stein said. "The next wave of applicants that are either in pre-application now, or thinking about submitting an application in the next year or two are going to benefit tremendously from the lessons learned by TerraPower, X-energy, Kairos, and the lessons learned by the NRC in trying to review those applications at the same time," Stein added.

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