

Touring Oak Ridge's future nuclear energy hub (part 5): *TVA and Kairos Power*

(As published in The Oak Ridger's Historically Speaking column the week of March 9, 2026)

Carolyn Krause is exploring what's happening in Oak Ridge. She has read that new companies are investing in building facilities on Oak Ridge land partly for creating tomorrow's nuclear reactors and making the special fuels they need to power future data centers for advancing artificial intelligence.

The companies will help to meet the goals of the Department of Energy's Manhattan Project 2.0. DOE is aiming to ensure that the United States maintains its global leadership in AI and its competitiveness in national security, economic prosperity, and scientific discovery through supercomputing and quantum computing. AI data centers require electricity 24/7, and of all the energy sources, nuclear power is the most reliable, generating electricity more than 90% of the time.

Past accomplishments can lay a path for future achievements. As this Historically Speaking column has often mentioned, researchers in Oak Ridge and elsewhere learned in the past century how to make nuclear fuel and nuclear reactors, on land and sea, that have used the fuel for decades to produce electricity worldwide. Oak Ridge helped chart the way for developing advanced nuclear fuels and for designing easier-to-build, safer, more efficient, and less expensive small modular reactors that will require the new fuels to meet 21st century needs for power.

On Tuesday, Oct. 21, 2026, during Nuclear Science Week sponsored by the American Museum of Science and Energy in Oak Ridge, Carolyn took the New Nuclear "Dirt Tour" on a luxury bus paid for by Kairos Power. It helped her find out more about how and why Oak Ridge is becoming the "core of America's nuclear renaissance." The tour "guides," the lunch speaker, and passengers were well-informed about nuclear companies' plans for Oak Ridge, as well as her internet searches using AI chatbots, which provided excellent information, much of which she presents in this five-part series.

Two sites we visited in the afternoon in the luxury bus are owned by potential builders of small modular reactors. Both are expected to produce electricity but are different in several ways.

TVA. The Tennessee Valley Authority's plans and partnerships have elevated East Tennessee to a position of national leadership in nuclear energy.

The largest public utility in the United States, TVA aims to build and operate the nation's first commercial small modular reactor (SMR). It will be constructed at its Clinch River Nuclear Site, which consists of 935 acres on TVA's 1200-acre tract of land in Oak Ridge.

As our luxury bus drove around the site, Malinda Hunter (mhunter@tva.gov) of TVA's New Nuclear Communications, External Relations, pointed out that the site's newest improvement is a five-lane bridge so that the SMR reactor pressure vessel and other heavy equipment can be hauled on the site. She added that the TVA site now has 161,000-volt power lines, wider roads, potable water and silt fencing to prevent material from construction or road widening from migrating into the waterways.

An SMR is a compact nuclear reactor that, compared with traditional nuclear power plants, will generate one-third as much electricity (e.g., 300 megawatts electric or MWe) and take up less land than traditional large nuclear power plants such as those in the TVA system. The goal is to build the SMR faster at lower cost onsite using standardized, factory-fabricated components and to equip it with passive systems to enhance its safety.

For its flagship project, TVA plans to deploy a GE Vernova Hitachi BWRX-300 reactor. This Generation III+ light-water SMR will have a capacity of about 300 MWe per unit. The reactor will produce enough electricity to power about 300,000 homes.

Hunter said that TVA has technology collaboration agreements with GE and Ontario Power Generation, which is building an SMR at its Canadian site that TVA is following closely.

In 2019 the U.S. Nuclear Regulatory Commission (NRC) granted TVA an early site permit for its Clinch River Nuclear Site and approved it for up to four SMRs, Hunter added.

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During our ride, she pointed out wild turkeys, an osprey nest and the location of the giant hole that had been excavated in limestone for the proposed Clinch River Breeder Reactor. Congress canceled this project in 1983 because of cost overruns and nuclear weapons proliferation concerns. All I could see were tall trees that had grown taller than the rim of the excavation pit, which obviously is no longer a reactor site.

In May 2025, TVA submitted to the NRC a construction permit application, which the commission is actively reviewing. With this submission, TVA became the first U.S. utility to apply for an SMR construction permit.

In December 2025, the Department of Energy recently selected TVA to receive \$400 million in federal cost-shared funding. The purposes of the DOE money are to accelerate reactor deployment, reduce financial risk to consumers and help TVA target commercial operation in the early 2030s. TVA executives hope to start operation in 2032 of what might be America's first Generation III+ SMR.

TVA expects to employ up to 9,000 workers at peak construction of its first SMR. A much smaller but highly skilled staff will be required to operate it.

Partnerships. TVA also has developed partnerships with new nuclear companies in the Oak Ridge area. One example is Type One Energy, which will use the turbine building, switchyard and transmission system of TVA's retired Bull Run Steam Plant to create a power-producing fusion machine called a stellarator. It will harness the energy of a magnetically confined, superheated, heavy hydrogen plasma to produce electricity.

TVA also is a partner of Oklo, which intends to build in Oak Ridge the first privately funded nuclear fuel recycling facility in the United States. With BWXT, TVA is participating in a coalition of major domestic nuclear supply chain partners to ensure the U.S. can domestically manufacture the necessary components for advanced nuclear reactors and producers of nuclear fuel.

TVA is a strong partner with Kairos Power, which is planning to build two Generation IV, salt-cooled Hermes reactors on its Oak Ridge site. The second reactor, called Hermes 2, will produce 50 megawatts of electricity by 2030.

On August 2025, TVA and Google announced a power purchase agreement (PPA) in which Kairos Power would sell the electricity from the Hermes 2 reactor's power plant to TVA's grid starting in 2030; in turn, TVA will deliver the equivalent amount of power to Google AI data centers in Montgomery, Tennessee, and Jackson County, Alabama, so that Google gets some of the clean energy credits it needs.

This partnership marks the first time that a U.S. utility has signed a PPA to buy electricity produced by an advanced reactor and to feed that amount of power to AI data centers. The centers' purposes are to develop and test AI models and train them so they can be safely deployed for real-world use. Signing the PPA also accelerated Kairos Power's timeline for commercializing its advanced salt-cooled reactor as a power source.

As part of a Master Plant Development Agreement with Google, Kairos Power plans to build a fleet of dual-unit reactors by 2035 that will generate up to 500 megawatts-electric (MWe) of commercial electricity for Google's AI data centers.

Kairos Power. In 2023 and 2024, Kairos Power received two construction permits from the U.S. Nuclear Regulatory Commission for its two planned salt-cooled reactors (a first for a non-water-cooled reactor). As of December 2025, NRC had not yet granted TVA a construction permit.

In July 2021, Kairos Power purchased a 207-acre parcel for its nuclear power demonstration project. It is now constructing its first reactor, called Hermes 1, on the tract of land where the K-33 Gaseous Diffusion Plant once enriched uranium, said a senior engineer on Kairos Power's site integration team. The bus traveled slowly by the foundation pad of Hermes I so the passengers could see what he called "52 drilled piers about three-and-a-half feet wide that go down almost 50 feet to bedrock."

The next steps, he noted, are to add a four-foot-thick concrete pad, a "seismic isolator" to protect the building from damage by an earthquake, and then another six-foot-thick slab of concrete on which the reactor building will sit.

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The 35-megawatt thermal (MWT) advanced reactor will produce nuclear heat only after it receives an NRC license. Kairos Power plans to submit the Hermes 1 operating license application this year and is targeting operations starting in 2028.

The company calls its unique reactor design the Fluoride Salt-Cooled High-Temperature Reactor (KP-FHR). It uses molten fluoride salt coolant and TRISO particle fuel embedded in graphite pebbles, almost like the nuclear products of the TRISO-X subsidiary of X-energy and of Standard Nuclear, both located in Oak Ridge.

Both the coolant and fuel used by Kairos Power are based on innovations at Oak Ridge National Laboratory. One breakthrough was the successful Molten Salt Reactor Experiment (MSRE) built and operated in the 1960s at ORNL.

There, a mixture of lithium fluoride and beryllium fluoride (FLIBE) was tested; that's the same salt coolant Kairos Power will use in its reactors.

The other ORNL development that is being modified for use in Kairos Power reactors is the TRISO fuel designed for high-temperature, gas-cooled reactors that were never built and operated. Kairos Power is repackaging TRISO into a new fuel form suitable for KP-FHR reactors and developing manufacturing methods to mass-produce that fuel in collaboration with Los Alamos National Laboratory and BWXT.

The TRISO fuel is embedded in graphite pebbles the size of golf balls. Tens of thousands of them make up the reactor core. Embedded in each pebble are tens of thousands of particles the size of poppy seeds, each coated in multiple carbon layers.

The innermost layer, the kernel, is a sphere of fissile material made of uranium oxycarbide; it has a uranium enrichment level that is close to 20% uranium-235 (High-Assay Low-Enriched Uranium, or HALEU).

The multi-layered structure makes each particle highly resistant to corrosion, irradiation and high temperatures and prevents it from releasing radioactive fission products. The pebbles will not melt or leak radiation during reactor operation.

At the entrance to the Kairos Power site, the engineer speaking on the bus noted that staff at ORNL's Manufacturing Demonstration Facility (MDF) in Knox County partnered with Kairos Power to develop and validate large-scale, 3D-printed molds made of a carbon-fiber-reinforced plastic (polymer composite). The molds made at MDF and in partnership with the University of Maine's Advanced Structures & Composites Center will be used to cast more concrete columns with complex shapes like the ones on display at the entrance to the site.

"From overhead, the top of this column looks like a nuclear radiation symbol," the engineer said.

"The actual reactor building will have columns that interlock at grooves. The columns provide radiation shielding by removing any pathways for neutrons to stream out of the reactor area."

Next to the entrance (which now has a guard) is the non-nuclear, Engineering Test Unit 3, or ETU 3, facility. In Albuquerque, N.M., the first iteration, ETU 1, was the world's largest FLIBE system, built to test system integration and operation at high temperatures. Kairos Power decommissioned ETU 1 in 2024 and is now building ETU 2 in its place. ETU 2 is Kairos Power's first fully modular system. The company fabricated the reactor vessel for ETU 2 following stringent quality control standards in its ASME-certified vessel shop in Albuquerque.

At Oak Ridge, ETU 3 serves as a proving ground for advanced manufacturing methods, including electron beam welding for construction of a prototypic reactor vessel, for training operators, and for testing robots and other equipment for remote handling and maintenance to ensure safe and efficient operation of the Hermes reactors. With all this activity and planned construction, the number of local workers at Kairos Power in Oak Ridge should be growing from 60 to more than 200 in the next five years.

Reactor comparisons. How do TVA and Kairos Power reactors compare?

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None have received their operating licenses from NRC yet. The TVA's small modular reactor will produce more electricity (300 MWe) than Kairos Power's Gen IV Hermes 2 reactor (50 MWe). Here are other comparisons between TVA's Boiling Water Reactor (BWR)/Advanced Light-Water Reactor (Generation III+) and Kairos Power's Fluoride Salt-cooled High-Temperature Reactor (KP-FHR/Generation IV).

Coolant? (TVA) Water, which boils to create steam directly in the reactor vessel. (KP) Molten fluoride salt, which does not boil away and operates at low pressure.

Fuel form and uranium enrichment levels? (TVA) Traditional fuel rod assemblies with low-enriched uranium (LEU), like those in current large commercial reactors. (KP) TRISO particles with an inner layer of HALEU coated with carbon layers and embedded in a graphite pebble, so the fuel won't melt or release radiation.

Pressure level? (TVA) High pressure to keep the water liquid at high temperatures, like the three BWRs at TVA's Browns Ferry Nuclear Plant. (KP) Low, near-ambient pressure, enabling the use of less expensive containment vessels and other structures.

Design heritage? (TVA) A simplified, smaller version of the already-licensed Economic Simplified Boiling Water Reactor. (KP) A novel combination of technologies based on ORNL developments – molten salt from the MSRE and pebble bed fuel from HTGR projects.

Safety? (TVA) Passive safety features but still risks coolant loss. (KP) Inherent passive safety because the fuel tolerates high temperatures and the salt coolant cannot boil away.

For the TVA reactor, 80% of its components are based on licensed, proven technology, potentially accelerating its licensing and deployment.

The challenge for Kairos Power as a reactor pioneer is that it must prove that its novel reactors should be licensed because they can operate safely with a unique fuel and coolant. Kairos Power has been engaging with the NRC since 2018 and has made significant progress in navigating the regulatory pathway for its technology. The NRC has issued three construction permits to Kairos Power and approved 14 topical reports supporting the licensing basis for KP-FHR technology.

The company must also develop the supply chain to enable commercial deployment of its technology. Kairos Power is investing heavily in its vertical integration strategy to produce critical components in-house, including salt and fuel, to mitigate supply chain risk and make Generation IV reactors a viable source of 24/7 electrical power in the 2030s.

Thank you, Carolyn, for continuing your review of the nuclear companies featured on the Nuclear Science Week's "Dirt Tour." This is the last of a five-part series being published in Historically Speaking.

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TVA's Clinch River Nuclear Site is being prepared for Small Modular Reactors (Courtesy of Halley Lewis)

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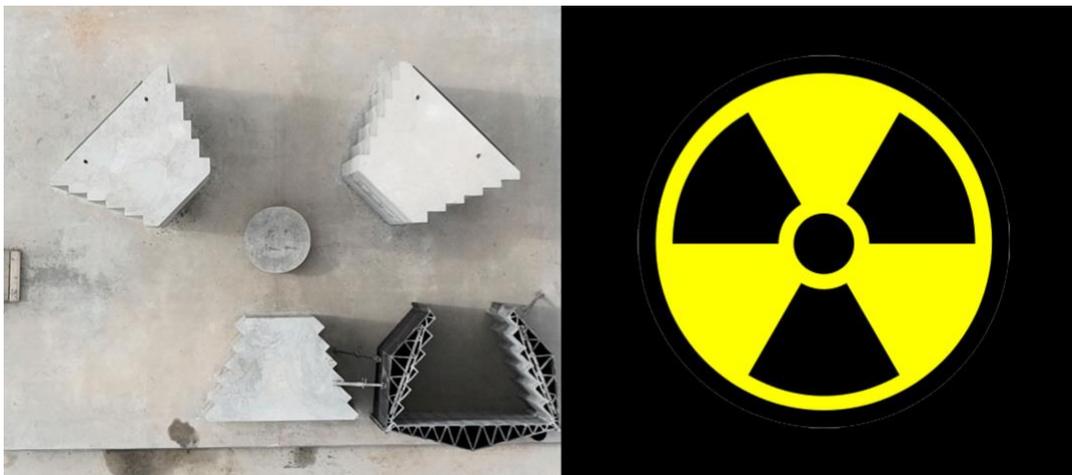
Kairos Power building as seen from the Wilcox K-25 Interpretive Center (Courtesy of Ray Smith)

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The Janus Project signage (Courtesy of Kairos Power)



Looking from above, the Janus Project signage is shaped like the radiation symbol (Courtesy of Kairos Power)

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Hermes and ETU 3 footprint (Courtesy of Kairos Power)