

Touring Oak Ridge's future nuclear energy hub (part 3): *TRISO-X, Standard Nuclear, Radiant Nuclear*

(As published in The Oak Ridger's Historically Speaking column the week of February 23, 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," lunch speaker, and passengers were well-educated on 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.

A new type of fuel for advanced reactors that will operate at high temperatures was partly pioneered by Oak Ridge National Laboratory, which advanced the development and qualification of this fuel, called TRISO, in the United States. It plays an important part in the nuclear energy ecosystem in Oak Ridge.

TRISO-X and X-energy. The bus passengers first had a chance to survey the Horizon Center Industrial Park on the way to the first stop at the edge of a 110-acre plot purchased in 2022 by TRISO-X, a wholly owned subsidiary of X-energy, which plans to build small modular reactors. TRISO-X will produce fuel for the reactors based on an ORNL innovation.

After the speaker on the bus introduced us to TRISO-X, I began thinking about the importance of three acronyms – SMR, HALEU, and TRISO.

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) and take up less land. 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.

Many SMRs will run at high temperature and low pressure, enabling more efficient and safer operation. They will cost less because a huge pressure vessel won't be required. The preferred fuel for increasing efficiency is High Assay Low Enriched Uranium, or HALEU. That's uranium enriched in fissionable uranium-235 at a level between 5% and 20%, but often at 19.75%.

By comparison, the light-water reactors that produce almost 20% of the electricity consumed in the United States use uranium with only a 3 to 5% concentration of uranium-235. But in what form will the HALEU fuel take?

In many cases, the HALEU produced in the future by Centrus Energy and Orano USA centrifuges will be encapsulated in TRISO (TRi-structural ISOtropic) particle fuel. HALEU will be at the heart of the thousands of particles in each of the TRISO fuel pebbles in each SMR's core. Thanks to nuclear fission

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(splitting of the nuclei of atoms) occurring in the innermost part of each particle, SMRs' cores will release massive amounts of heat that is used to make steam to spin a turbine that generates electricity.

Although this fuel form was first developed in Germany and the UK in the 1950s, ORNL's research has been central to modernizing and proving the fuel's performance for the current generation of advanced reactors (except for Oklo's Aurora reactors mentioned in the previous article that may use recycled HALEU fuel in metal form). ORNL's research was originally intended for high-temperature, gas-cooled reactors that were never built and commercialized.

DOE calls TRISO the most robust nuclear fuel on Earth. It will likely be the chosen fuel for most SMRs and other next-generation reactors. The reason: these low-pressure reactors will operate at high temperatures, making them more efficient than traditional reactors. TRISO fuel will remain stable and not melt when exposed to these advanced reactors' high temperatures.

In TRISO fuel, the entire particle, consisting of a uranium oxycarbide kernel surrounded by multiple protective ceramic and carbon layers, is about the size of a poppy seed. The coatings include a silicon carbide layer that retains the radioactive fission products of the uranium fuel, minimizing radiation releases to outside of the reactor core.

Some 19,000 of these particles are pressed together in a graphite matrix to make a pebble, the size of a golf ball. More than 200,000 pebbles are cycled multiple times through the core through which the coolant passes until analysis indicates no energy is left.

The higher enrichment of HALEU allows an SMR using it to have a smaller reactor core. The HALEU fuel can remain in the reactor longer, increasing efficiency and reducing downtime.

The manager of construction for the TRISO-X site told the bus passengers that TRISO-X is a wholly owned subsidiary of X-energy, an advanced nuclear reactor and fuel design engineering company based in Maryland. X-energy is planning to build Xe-100 small modular reactors that will use TRISO fuel.

The TRISO-X operation started at ORNL in 2016, where a pilot plant is fabricating and producing TRISO-X fuel. Some of the TRISO fuel from ORNL is undergoing irradiation testing at DOE's Idaho National Laboratory.

The transition from ORNL to the TRISO-X site at the Horizon Center Industrial Park will take place over the next three years. Vertical construction on a concrete foundation had begun in October on the \$300 million TX-1, the TRISO fuel production facility of X-energy. By the end of the year, 135 employees will be building it.

TX-1 will be built by 2026, but it will not go into operation with a staff of 500, including former ORNL employees, until 2027. The company has stated that the TX-1 facility could meet the fuel needs of 11 Xe-100 reactors. Early next year at the Horizon Center, X-energy may start building TX-L, which will provide lab space for additional research on developing improved TRISO fuel and possibly other types of nuclear fuel. If X-energy chooses to build TX-2, the construction and operation of that facility will provide 1,200 jobs.

X-energy executives hope that by May 2026, TX-1 will be the first Category II fuel fabrication facility licensed by the Nuclear Regulatory Commission and the first-in-the-nation facility to exclusively manufacture five metric tons a year of TRISO fuel for SMRs in the United States. If X-energy chooses to build TX-2 in Oak Ridge, more than 1,200 people will be employed at the Horizon Center site.

X-energy, which recently entered a partnership with the AI company Amazon, plans to build Xe-100 small modular reactors of a particular type: pebble-bed, high-temperature, gas-cooled (HTGR) reactors. The Xe-100 SMR will be fueled by X-energy's proprietary TRISO-X fuel. Each Xe-100 module will generate

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about 80 megawatts-electric (MWe) and 200 megawatts-thermal (MWt). The standard plant design consists of a four-pack configuration, producing a total of about 320 MWe.

X-energy has formed a significant partnership with Dow Inc. to build a four-unit Xe-100 plant at Dow's site on the Texas Gulf Coast, where it makes a wide variety of chemical and plastic products. The goal is to provide Dow with cost-competitive, low-carbon process heat and power to reduce its carbon emissions.

Standard Nuclear. In October 2024, Ultra Safe Nuclear Corporation (USNC), which had been operating in the Heritage Center Industrial Park since 2021, filed for bankruptcy due to financial difficulties exacerbated by the passing of its principal investor. This advanced nuclear energy company had been focused on developing microreactors and capabilities for producing TRISO fuel for these advanced reactors.

Standard Nuclear emerged when it purchased USNC's fuel-related assets for \$32.5 million through a bankruptcy auction. Its acquisition included the commercial-scale technology and production capabilities in Tennessee to manufacture TRISO nuclear fuel.

Standard Nuclear today has more than 50 employees and three operating facilities in Tennessee that house TRISO production capabilities along with other advanced manufacturing capabilities. The company is deploying commercial-scale production facilities along multiple fronts including deployment of a new facility in Oak Ridge under DOE Authorization as part of the DOE Pilot Fuel Line dedicated to production of TRISO-based fuels.

One key difference between X-energy (including its TRISO-X subsidiary) and other companies with plans to produce TRISO nuclear fuel is that Standard Nuclear is truly a reactor-agnostic fuel producer. It is the only fuel manufacturer not designing and deploying its own reactor as well. Standard Nuclear is solely focused on providing fuel for advanced reactors and the operators that will eventually own and operate nuclear power plants housing these reactors. Standard Nuclear's goal is to ensure that a competitive fuel supply, at large scale and at low cost, is available for advanced reactors coming to the market.

Radiant Nuclear. One confirmed customer for Standard Nuclear's TRISO fuel is Radiant Nuclear (<https://www.businesswire.com/news/home/20260107671491/en/Standard-Nuclear-First-to-Receive-HALEU-Feedstock-for-Production-of-TRISO-Fuel-to-Support-2026-Reactor-Demonstration>), which purchased property at the end of Enrichment Street on Oct. 13, 2025, from the Oak Ridge Industrial Development Board. The company stated it would invest \$280 million in the mass production of nuclear generators, also known as Kaleidos microreactors. The state said that in return for Radiant's investment, it would give the company \$2 million from the Tennessee Nuclear Energy Fund. Each of these portable HTGRs will generate one megawatt of electricity (1 MWe) and, with its shielding and power conversion system, fit inside a single shipping container for easy transport by truck, ship or air.

Kaleidos microreactors, which will be cooled by helium, are intended to serve as clean alternatives to diesel generators for providing backup power for rural hospitals and data centers, and off-grid power for remote villages and military installations.

Doug Bernauer, the company founder, once worked for Elon Musk at SpaceX. There, he was inspired to consider making nuclear devices that might be able to sustain life on Mars and other planets. Then he conceived of microreactors that would have uses on Earth.

Not far from Radiant's property is land owned by Kairos Power, which plans to use TRISO fuel in its two Hermes reactors. The first reactor will use TRISO fuel that the company developed with DOE's Los Alamos National Laboratory, and Hermes 2 will make electricity by consuming TRISO fuel jointly made by BWXT and Kairos Power.

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Next: BWXT and LIS Technologies offer different approaches to making enriched uranium for nuclear reactors.

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



Triso-X construction site in Horizon Center (Courtesy of Ray Smith)

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Standard Nuclear building in Heritage Center (Courtesy of Ray Smith)

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Radiant Nuclear site in Heritage Center located on the former K-27 site (Courtesy of Ray Smith)