Westinghouse eVinci Micro-reactor Overview

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Introduction:
Westinghouse eVinci Mirco-reactor Overview

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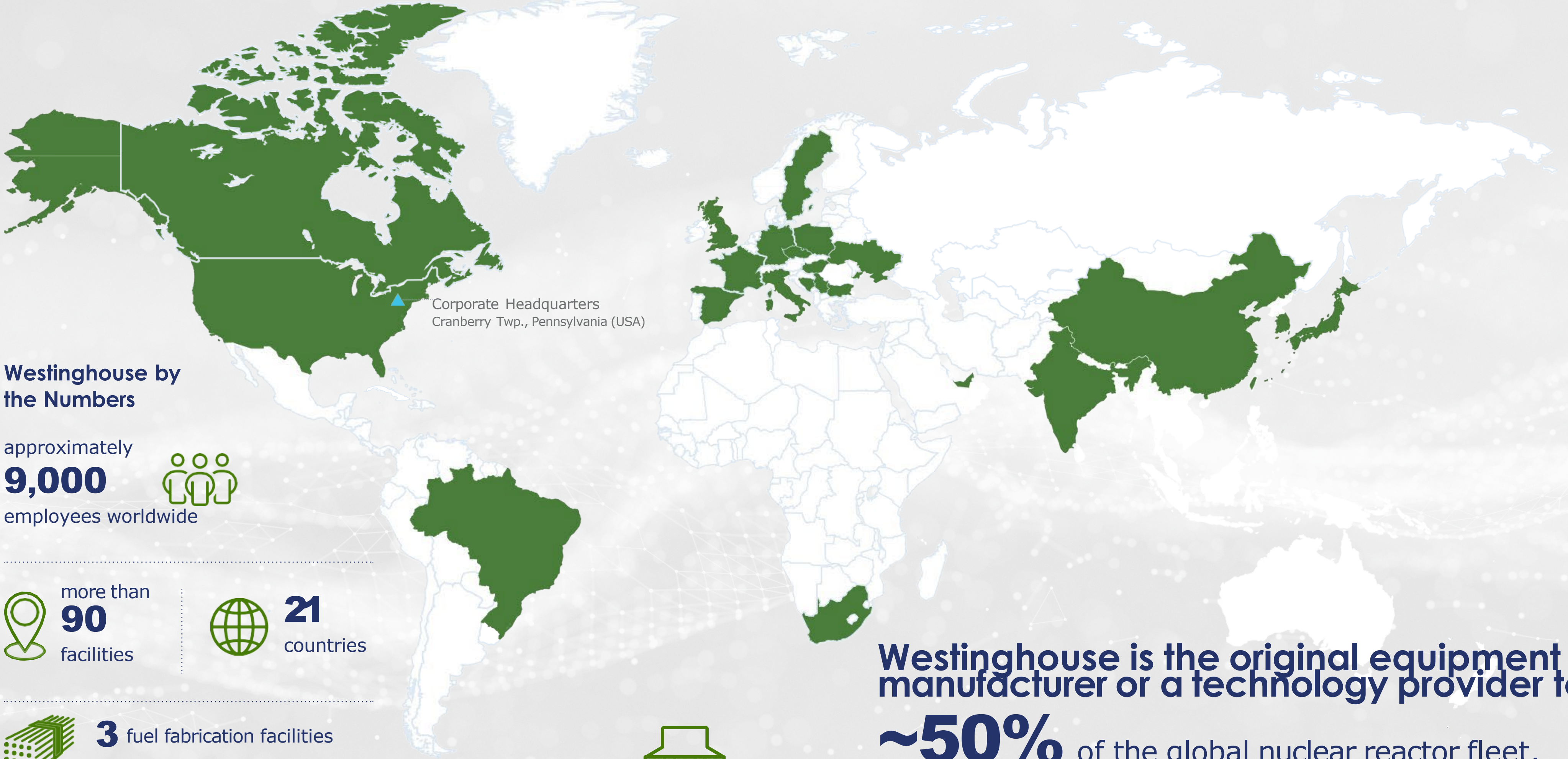
Westinghouse Overview

Global presence

Legend

- Corporate Headquarters
- Countries with Westinghouse Presence



Westinghouse by the Numbers

approximately
9,000
employees worldwide

more than
90
facilities

21
countries

3 fuel fabrication facilities

Westinghouse is the original equipment manufacturer or a technology provider to:

~50% of the global nuclear reactor fleet, delivering capacity of ~190,000 carbon-free MWe

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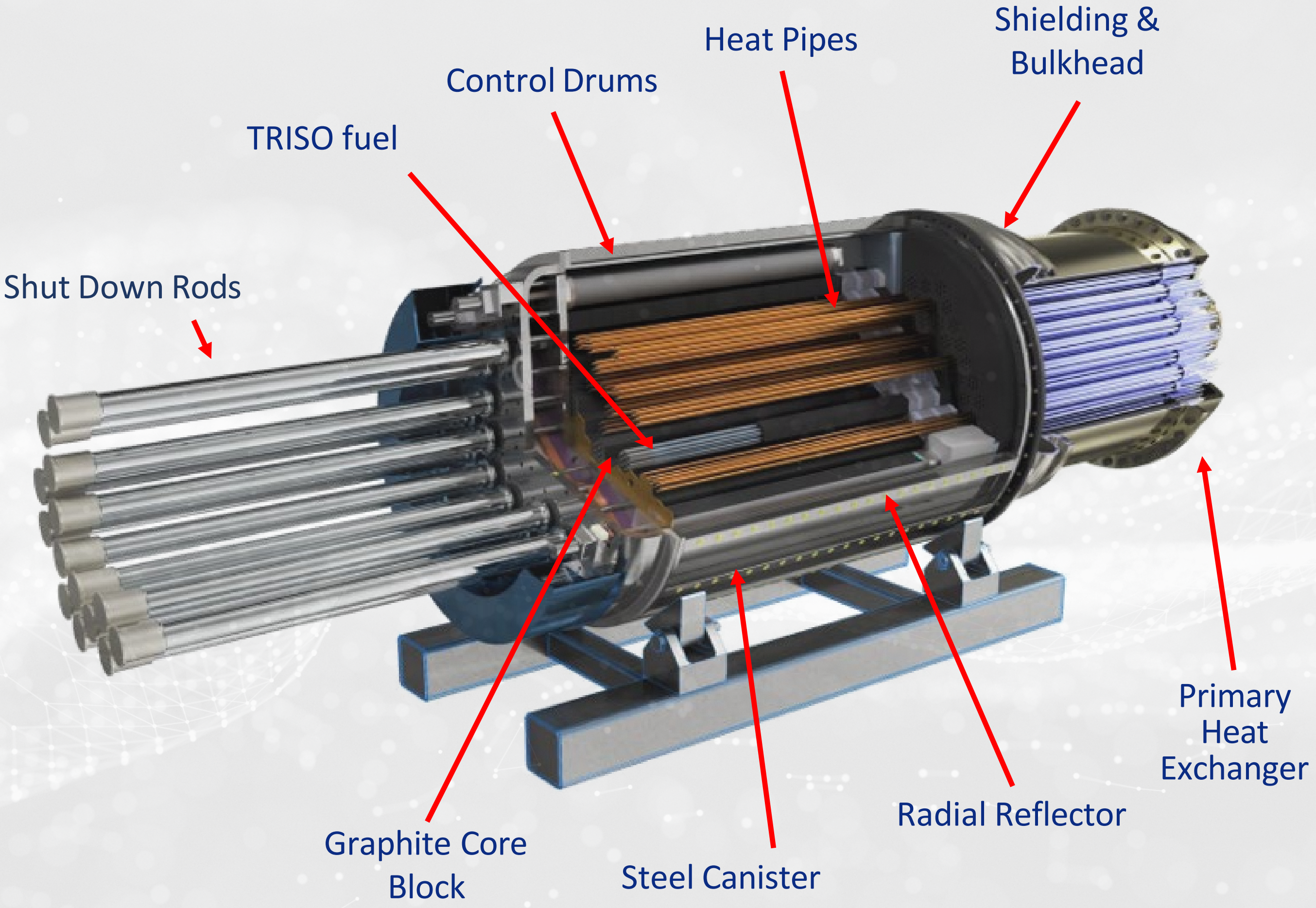
eVinci Microreactor Capability

Nuclear battery designed for safe and reliable electricity and heat generation

Technical Capabilities

- 5 MWe + ~8MWth @ 150C cogeneration
- Or 15MWth @750 C heat only
- Minimum 8 year refueling cycle
- High speed load-following capability
- Transportable for ease of installation
- Elimination of spent fuel storage on site
- Flexible for heat and power
- Cost-competitive plant lifecycle
- Minimal onsite personnel
- Mature technology, manufacturing, and regulatory readiness



eVinci Site

0.81 ha, above ground footprint

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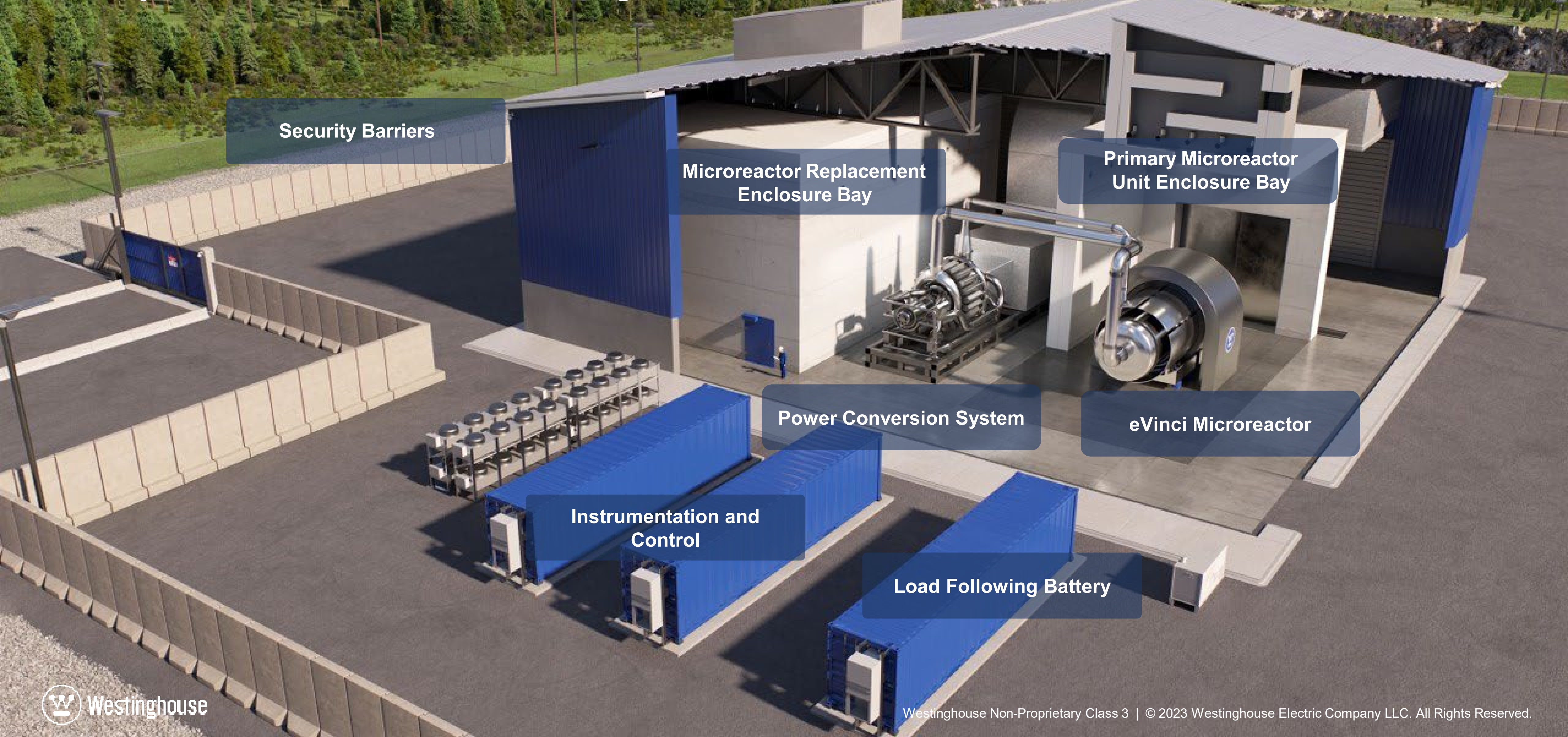
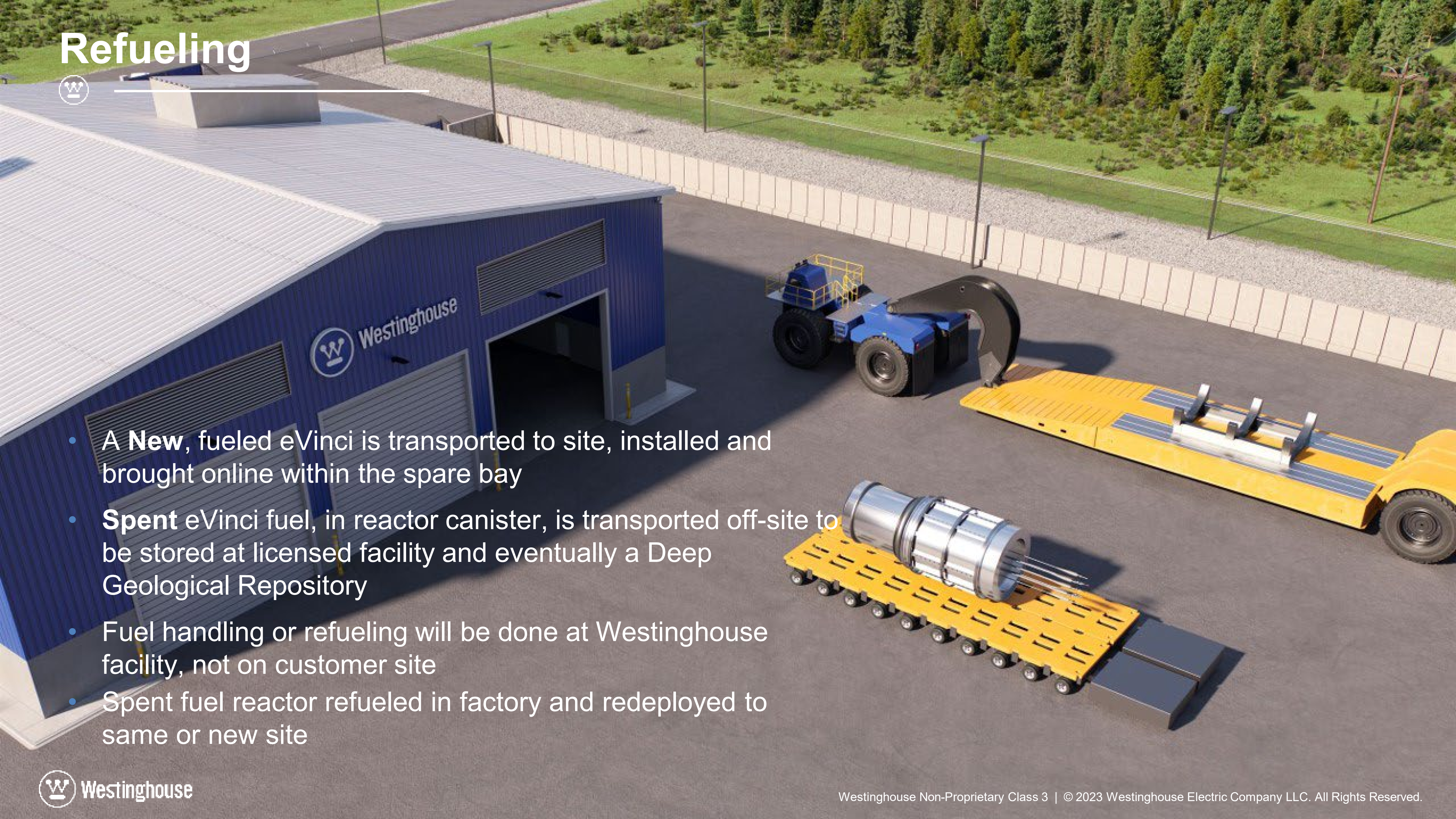
eVinci Site

System fits within a 60x60m building



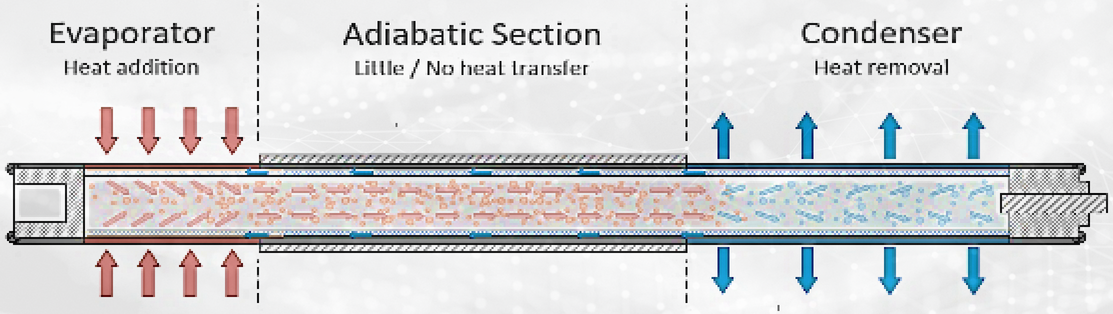
Refueling

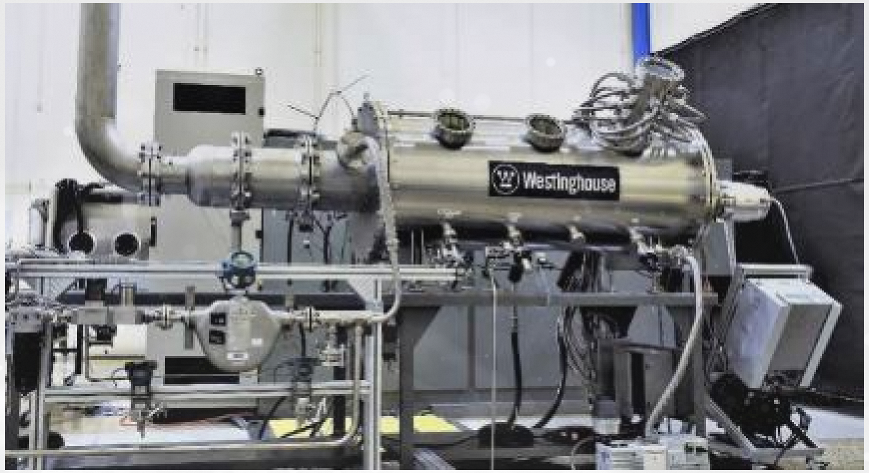


- A **New**, fueled eVinci is transported to site, installed and brought online within the spare bay
- **Spent** eVinci fuel, in reactor canister, is transported off-site to be stored at licensed facility and eventually a Deep Geological Repository
- Fuel handling or refueling will be done at Westinghouse facility, not on customer site
- Spent fuel reactor refueled in factory and redeployed to same or new site

Heat Pipe Technology

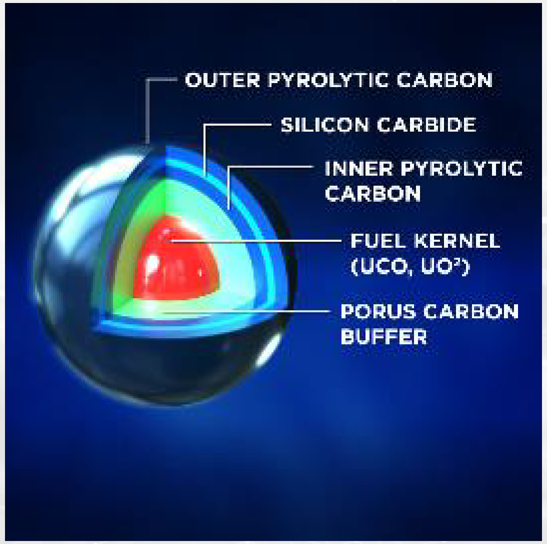
Sodium filled, low pressure heat pipes enable passive heat removal

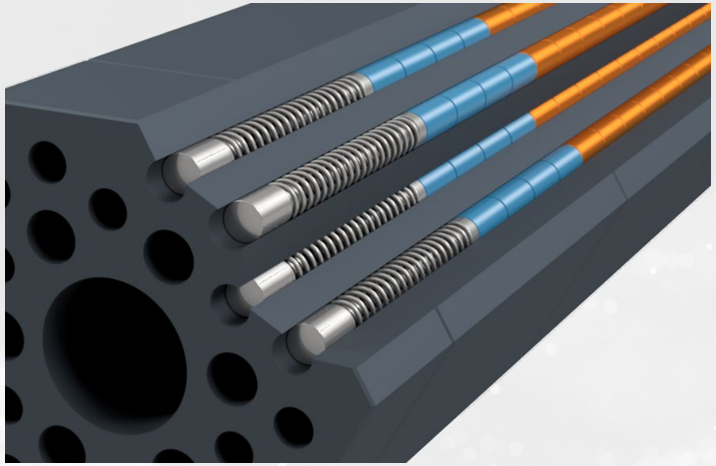




eVinci uses 19.75% enriched TRISO fuel

- The design uses HALEU UCO TRi-structural ISOtropic particle fuel
- Unlike most other reactors, eVinci microreactor is designed to operate at atmospheric pressures, eliminating risk of fission product release.
- The highest level of safety of fuel and radiation is maintained within many redundant layers of **functional containment.**

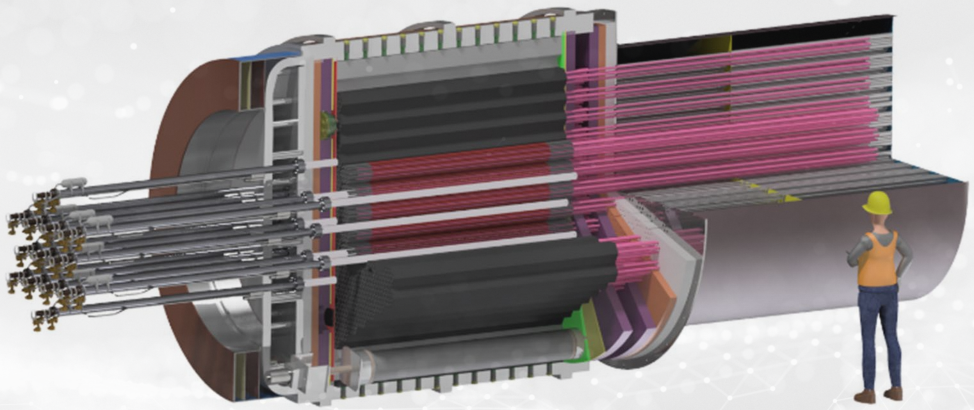




In collaboration with Urenco, Westinghouse was awarded a grant from the United Kingdom's Department for Business, Energy and Industrial Strategy (BEIS) to complete a Pre-Front End Engineering Design study for a secure and reliable supply of advanced TRISO to support a range of potential technologies in development.

October 26, 2022

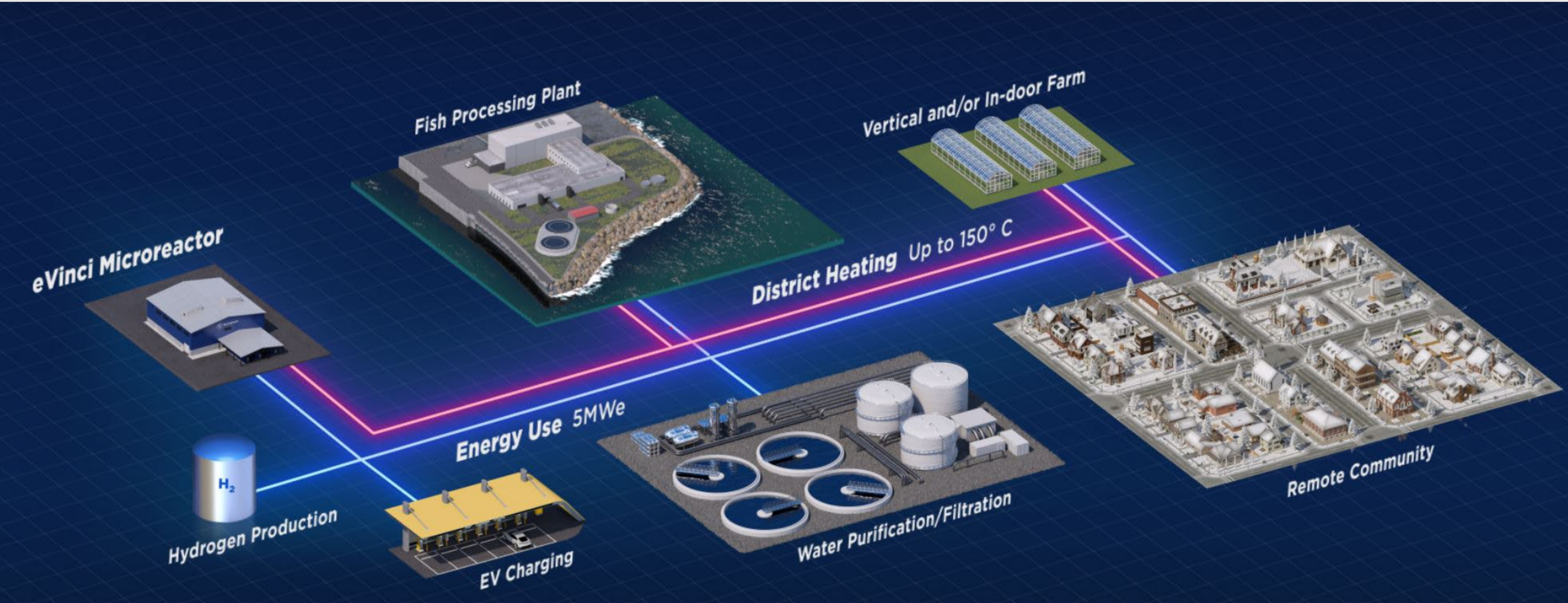
eVinci Microreactor Applications



Power & Heat via eVinci™ Microreactor

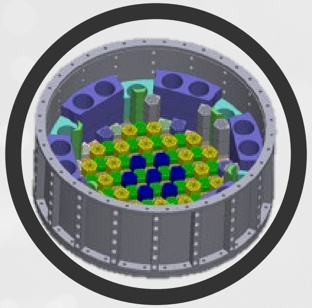
- Industrial Heat and Power
- Hydrogen Production
- Remote Industrial (Mining)
- Off Grid Communities (Heat & Power)
- Micro-Grids/ Critical Infrastructure
- Disaster Recovery
- Universities
- Strategic Military Installations
- Space Missions

Co-Generation Heat and Power Capabilities



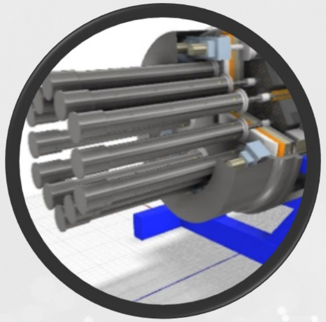
Technology Development and Timeline

2021–2022
- Conceptual design complete
- Electrical demonstration unit operational
- Initiated licensing engagement with US and Canadian regulators



2023
- NTR design for procurement
- Integrated manufacturing demonstrations and prototyping
- Separate effect and component testing

2024
- NTR component fabrication
- Criticality, transient, and irradiation testing
- eVinci design for manufacturing



2025–2026
- NTR assembly and operation
- Analysis code validation
- Initiate eVinci manufacturing
- Power conversion system testing

2027+
- eVinci design complete
- Receive regulatory licensing approvals
- Commercial unit delivery and operation

US NRC pre-licensing engagement
(Technical papers & Topical report submittals)

Prepare & submit design license to NRC

NRC review & approve design certification

Canadian Nuclear Safety Commission (CNSC) vendor design review

Other countries' licensing activities

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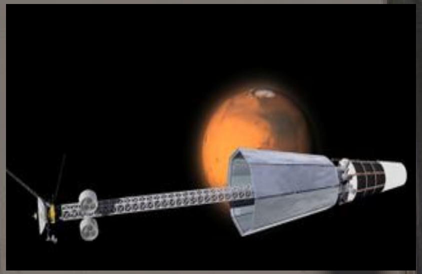
eVinci Technologies Achievements- Q4 2023

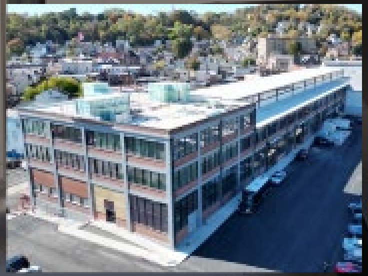


$16.9M awarded from Air Force Research Laboratory's (AFRL) JETSON thermal propulsion contract

October 2

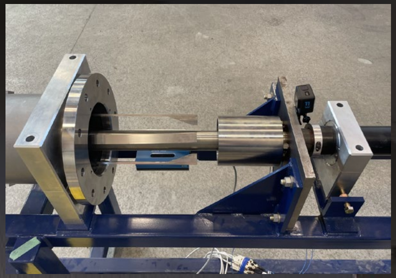
Selected by Idaho National Labs for FEEED study to plan for deployment of the eVinci Nuclear Test Reactor at INL

October 23



Launch of the eVinci Technologies Accelerator at 51 Bridge St. Etna, PA

October 24



Completed testing of key safety components Control Drums and Shut Down Rods

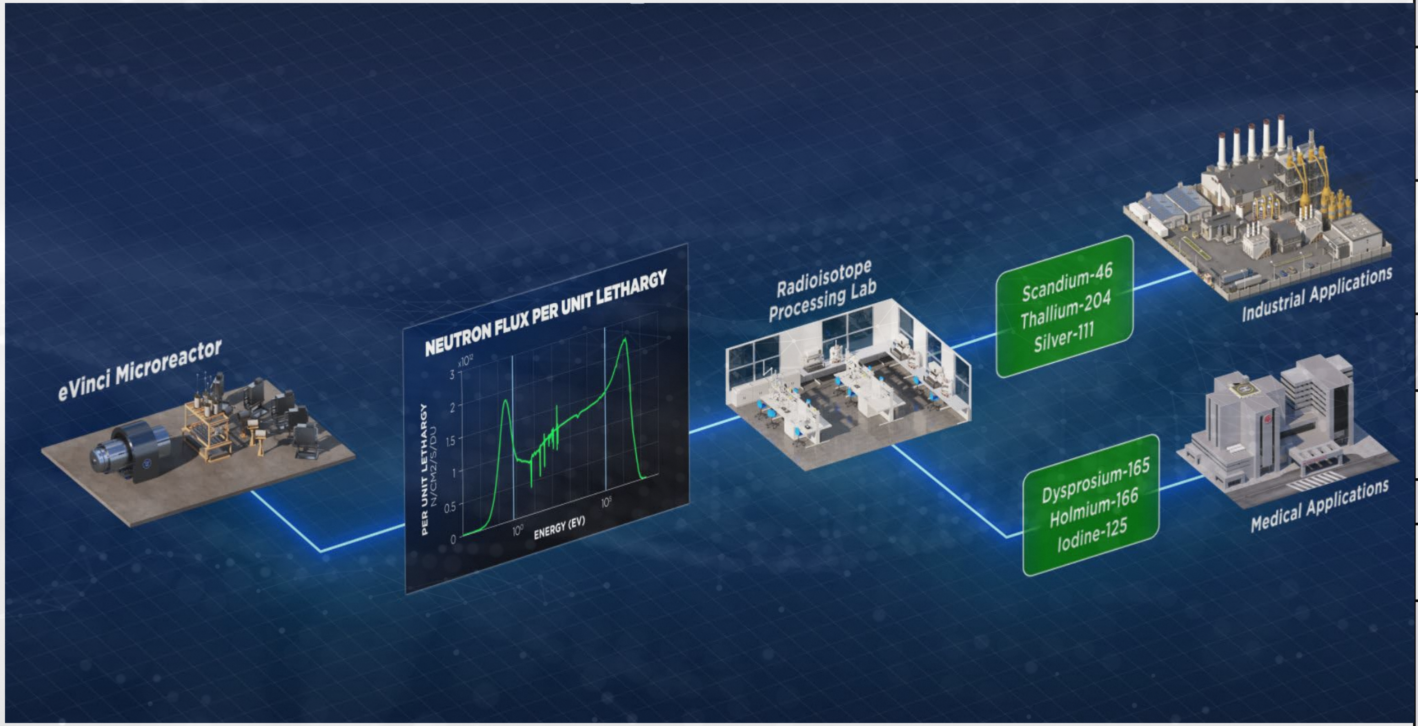
November 6

First eVinci customer announcement in Saskatchewan with Saskatchewan Research Council

November 27

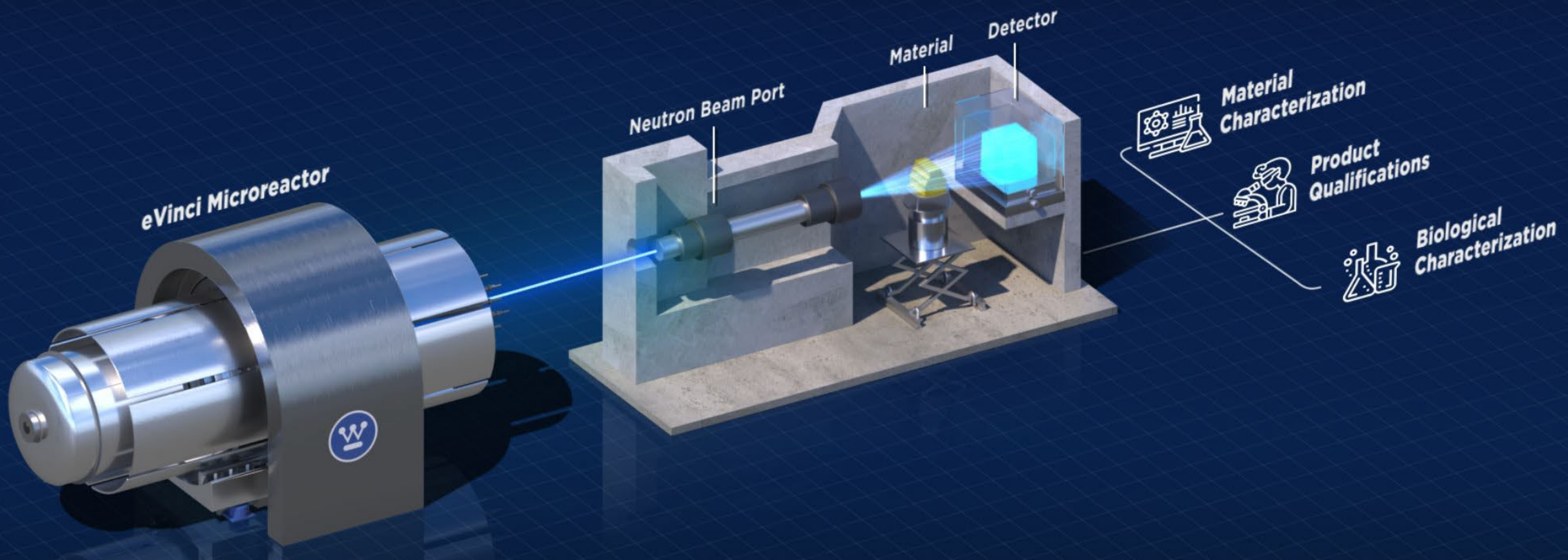
Research Applications

- Initial screening shows the following isotopes may be well suited for production in the eVinci Microreactor:
  - Chromium-51
  - Dysprosium-165
  - Holmium-166
  - Iodine-125
  - Iodine-131
  - Iridium-192
  - Copper-67
  - Gold-198
  - Mercury-197
  - Palladium-109
  - Phosphorus-33
  - Platinum-195m
  - Palladium-103
  - Rhenium-186
  - Rhenium-188
  - Samarium-153
  - Sodium-24
  - Ytterbium-169
  - Scandium-46
  - Silver-111
  - Sulphur-35
  - Tellurium-123m
  - Thallium-204
  - Thulium-170



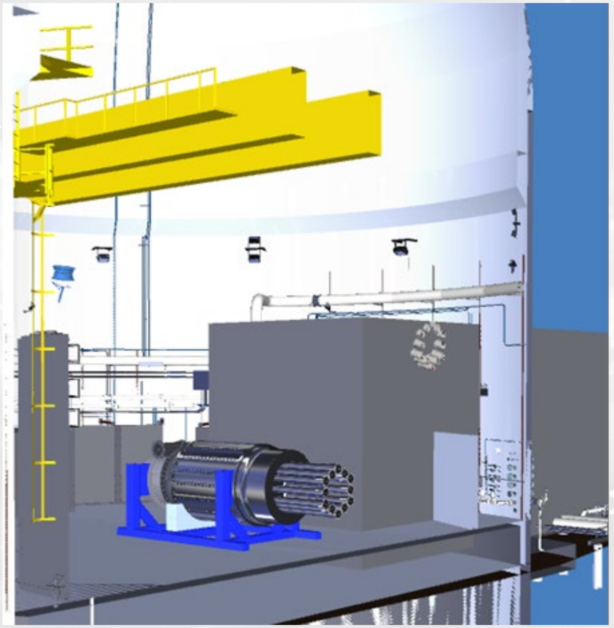
Cat. No.	Category	Sub Cat No.	Sub-option
1	Education and Training	1.01	Public Tours and Visits
		1.02	Teaching Physics and Biology Students
		1.03	Teaching Radiation Protection and Radiological Engineering Students
		1.04	Teaching Nuclear Engineering Students
		1.05	NPP Operator Training
2	Neutron Activation Analysis (NAA)	2.01	Instrumental NAA (INAA)
		2.02	Prompt Gamma NAA (PGNAA)
3	Radioisotope Production	3.01	Radioisotope Production
4	Geochronology	4.01	Argon Geochronology
		4.02	Fission Track Geochronology
5	Transmutation Effects	5.01	Silicon Transmutation Doping
		5.02	Gamma Irradiation
		5.03	Gemstone Coloration
6	Neutron Imaging	6.01	Neutron Imaging (2D and 3D tomography)
7	Material Structure and Dynamics Studies	7.01	Material Sciences
8	Positron Sources	8.01	Positron Sources
9	Neutron Capture Therapy	9.01	Boron Neutron Capture Therapy (BNCT)
10	Testing	10.01	Instrument Testing and Calibration
		10.02	Neutron Irradiation
		10.03	Loops for Testing Nuclear Fuels

Neutron Imaging



eVinci Microreactor

- **DOE authorization for eVinci NTR operation in Idaho National Labs EBR-II DOME**
  - 1/5th thermal power scale nuclear test reactor
  - NTR needed to finalize computer codes V&V for licensing
- **DOE Authorization Application Milestones**
  1. Safety Design Strategy (SDS)
     a) Transmitted to DOE – April 11, 2023
  2. Preliminary Safety Design Report (PSDR)
  3. Preliminary Documented Safety Analysis (PDSA)
  4. Final Documented Safety Analysis (FDSA)
  5. Environmental Assessment (EA)



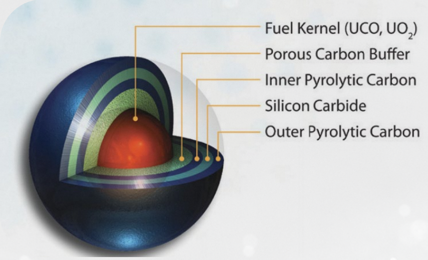
eVinci Fuel Design

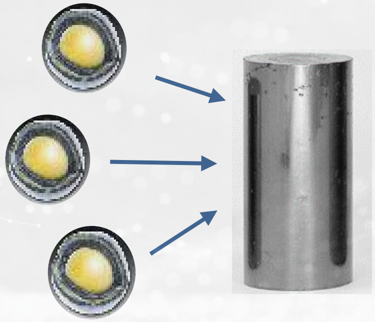
TRISO Benefits

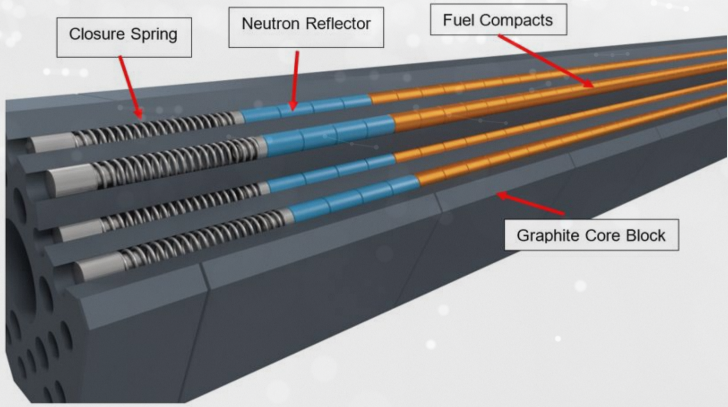
- TRISO fuel is a kernel of Uranium Oxycarbide (UCO) coated with tri-structural isotropic (TRISO) layers
- TRISO fuel is the only high temperature fuel that has regulatory acceptance and an extensive qualification basis
- The eVinci design baseline safety case credits the TRISO layers as a functional containment barrier

Why HALEU?

- Thousands of coated TRISO fuel particles are compacted into a graphite compact to form the TRISO fuel form
- HALEU enrichment levels provide the necessary uranium loading in the kernel to power the eVinci reactor to target power output and lifetime
- Compared to fuel of lower enrichment, HALEU allows for smaller reactor designs, longer core lifetimes, and increased fuel efficiency







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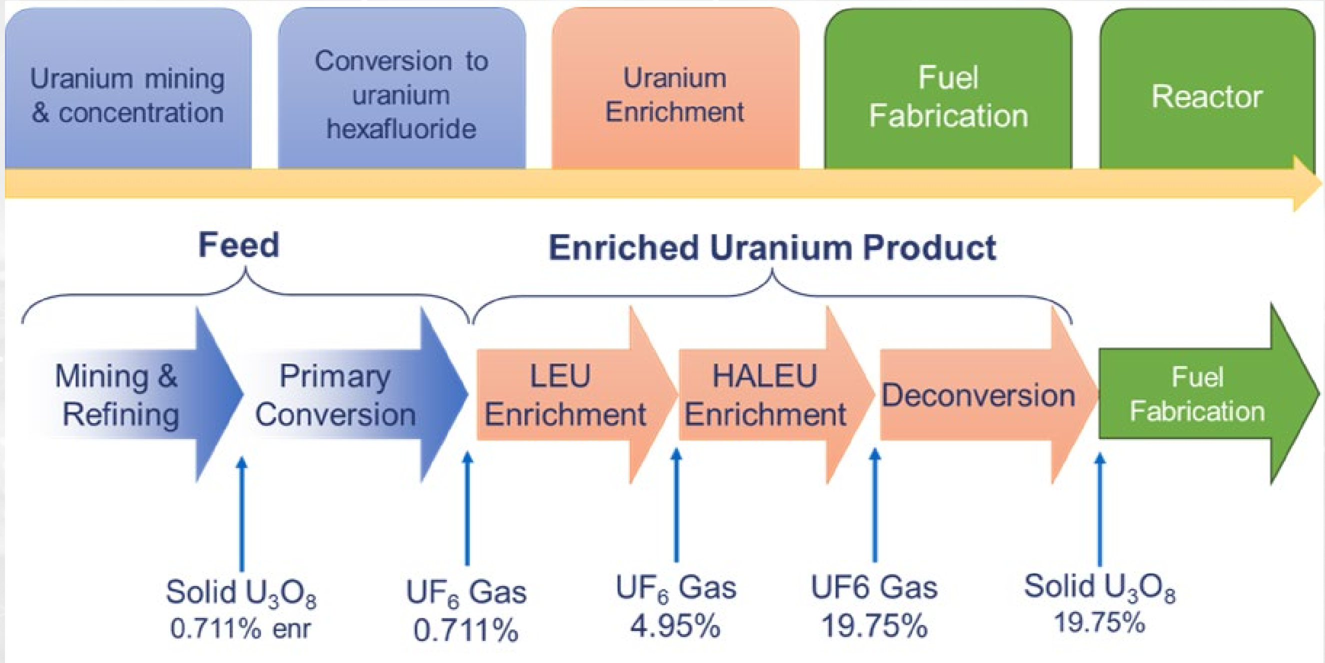
Fuel Fabrication Supply Steps

- There is currently no commercial-scale production of HALEU feed for advanced reactor fuel production outside of Russia
- Two challenges to address: enrichment to 20% and change of chemical form post-enrichment to be suitable for enrichment (“deconversion”)



HALEU Availability Timeline

- The US Government is running the “HALEU Availability Program” (HAP) with a goal of funding enrichment and deconversion by approximately 2028 to establish the market
- Urenco has privately shared their intention to build HALEU enrichment capacity in the US—with or without HAP funding—with first material available as early as mid-2028
- Centrus is enriching small quantities of HALEU under another US government program and will also compete via HAP to expand that capacity
- Deconversion HAP RFP to be issued this year
- US Government is making as much legacy stock available as possible until commercial availability—but this stock will be primarily for R&D/test reactors

Centrus’s AC100 Centrifuges

DOE Legacy HALEU Material

Commercial HALEU availability expected in 2029

Lack of domestic High Assay Low Enriched Uranium (HALEU) supply poses risk, but eVinci is engaging with both the Department of Energy (DOE) and independent enrichers

Westinghouse New Plants Portfolio

Scan to take a virtual tour

https://navigator-voyantstudios.com

Thank You

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navigator-voyantstudios.com/evinci-challenge.html