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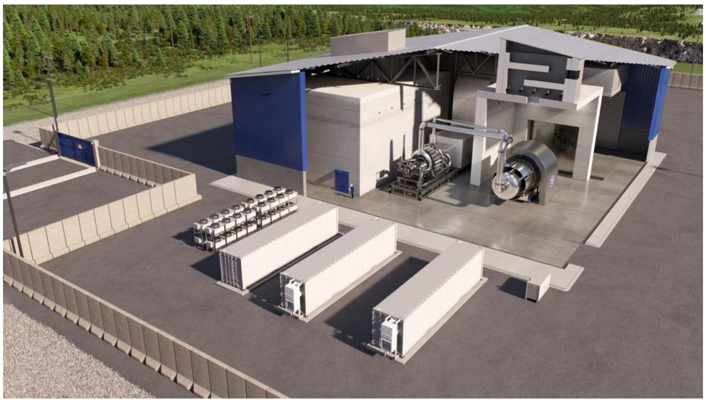
# The Case for Microreactors in Australia

***August 2025 Update***

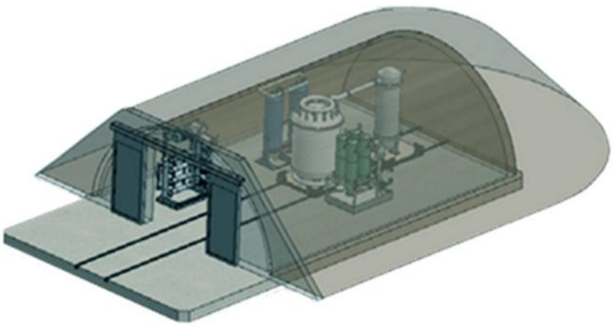


Westinghouse eVinci


Radiant Kaleidos


Nano Kronos

Oklo Aurora Powerhouse



BWXT BANR

## EXECUTIVE SUMMARY

**Microreactors are essentially “nuclear batteries”.**

**They are of unique potential value in off-grid applications, most especially for the mining industry.**

**The deployment of microreactors for off-grid electrical and heat will enable a transition away from diesel fuel to low emissions, reliable energy supply for off-grid mining sites, other key industries, critical infrastructure, energy-intensive operations like data centres, remote communities and disaster recovery**.

**ANSTO’s OPAL reactor at Lucas Heights has a thermal power capacity of 20 MW. Power reactors are banned under Australian law, but the OPAL reactor was licensed to operate as a research reactor**.

**Many microreactor designs have a lower thermal power than OPAL but are not allowed to be licensed because they are classed as “power reactors”**. **If the law were to be changed, these microreactors could provide essential services to Australian industry by replacing the high emissions from the use of diesel power.**

**Subject to regulatory change, microreactors will provide Australian companies with versatility and diversity in their future development.**

**Microreactors are designed to be inherently safe.**

**Microreactors are likely to join SMRs in contributing to the reduction of greenhouse gas emissions in Australia and other countries.**

## 1. What are microreactors?

Microreactors are essentially "nuclear batteries" designed to be competitive with diesel in off-grid applications. Large power reactors being deployed today have an average electrical output of 1,100 MWe which would supply about 1 million households. Large reactors are unsuitable for small grid systems or off-grid applications.

Because there is a need for low emissions electrical supply for smaller applications, Small Modular Reactors (SMRs) are being developed. These have an electrical output of up to 300 MWe. A form of SMRs has been deployed for many years in nuclear-powered submarines.

Even 300 MWe is too large for many off-grid applications and there is a growing interest in much smaller reactors with an electrical output of up to 10 MWe. These are commonly known as Micro Modular Reactors (MMRs) or simply microreactors.

## 2. Advantages of microreactors

The small physical size of a microreactor enables transport to site in shipping containers and quick on-site installation.
Microreactors are designed to safely supply any combination of electrical supply and process heat.
Microreactors have many other advantages:

- Provide reliable, low emissions power in all weather conditions
- Suitable for many locations including off-grid remote locations, small grid systems, mining operations, critical infrastructure, strategic military installations and date centres.
- Compact, factory assembled transportable module by rail, barge or truck reducing on-site installation time and reducing the risk of delays
- Quick on-site installation – months/weeks instead of years
- Scalable up and down, modules can be sized or added to meet demand
- Simple to operate and maintain, minimal on-site personnel
- Natural convection cooling of the reactor core
- Multipurpose – electricity + process heat + desalination
- Very compact, transport in shipping containers
- Very high level of passive or inherent safety – without the need for operator action or external electrical or water supplies
- Designed for a longer core life than typical large reactors
- Work with renewable energies in a microgrid, can load follow and load shed
- Can be used in emergency response scenarios to help restore power in the event of damage to the normal electricity supply.

## 3. Technological development

The majority of large reactors and many SMRs are based on light water reactor technology. Light water SMRs have an operating temperature of <300°C at the steam turbine inlet giving a thermal efficiency around 33%. The 300°C steam temperature limits their applications for process heat. There has been a developing interest in advanced reactors operating at higher temperatures with greater thermal efficiency and providing more opportunities for process heat. These are classed as *Generation IV* reactors. The research and development for their deployment is mainly driven by the *Generation IV International Forum (GIF)*, which has 13 member countries with major nuclear power programs led by the USA, plus Australia since 2016. Australia was invited to join GIF because of ANSTO's international reputation as a nuclear research organisation, particularly in the area of advanced nuclear materials. Australia has signed the GIF Framework Agreement and also the Systems Arrangements Agreement for the Very High Temperature Reactor (VHTR) and the MOU for the Molten Salt Reactor. Australia is in a good position to deploy these technologies. The VHTR in particular is the technology of choice for many microreactors.

In the USA, Idaho National Laboratories (INL) and the National Reactor Innovation Centre (NRIC) are enabling developers by providing technical resources, capabilities and a demonstration site. The US Federal Government is supporting development through funding and legislation. The US advanced reactor industry is developing several microreactor concepts and designs.

The Experimental Breeder Reactor II (EBR II) operated on the Idaho National Laboratory (INL) site from 1964-1994. Although the reactor has been decommissioned, the large concrete and steel containment dome has been retained. The dome is about 24m in diameter and 14m tall built of 1-inch-thick steel plating with a reinforced concrete structure. The DOE had the brilliant idea to repurpose the containment to test microreactors. The Demonstration of Microreactor Experiments (DOME) test bed is a demonstration platform that can test four to five advanced reactors, one at a time, up to 20 MW thermal power that use HALEU. It will allow safety-significant confinement for reactors to go critical for the first time. The facility will speed up microreactor development and save companies money in the testing process.

Dome test bed, operated by NRIC, image INL

- DOME will hold a shipping container sized MMR
- October 2023 - the DOE selected Westinghouse, Radiant Nuclear and Ultra Safe Nuclear Corp. (USNC) to conduct the first experiments at DOME.
- May 2025 - INL received priority rating authorization by the federal government to expediate the construction of the DOME test bed. "This priority rating will significantly reduce the time to secure the components and services we need to complete the test beds and help microreactor developers stay on their aggressive schedules" - Brad Tomer, Director of DOE's National Reactor Innovation Centre (NRIC).[1]
- 1 July 2025 - the DOE made conditional selections for Westinghouse and Radiant to perform the first tests in DOME. First fueled tests scheduled for spring 2026.[2]

## 4. The High Temperature Gas Reactor (HTGR) and TRISO fuel

One advanced reactor design that is very suitable for SMRs, including microreactors, is the High Temperature Gas Reactor (HTGR).

The HTGR is graphited moderated, helium cooled and is capable of operating at up to 900°C which would enable its use for most process heat applications and high efficiency electricity generation. The key advantage is the TRISO (TRi-structural ISOtropic) particle fuel. This consists of a very small uranium particle, <1mm diameter, surrounded by three layers of carbon- and ceramic-based materials that prevent the release of radioactive fission products. The particles are assembled into cylindrical blocks or billiard ball size pebbles. This fuel is safe to >1800°C and cannot melt in a HTGR.

*TRISO fuel – Half a mm diameter uranium fuel kernel coated typically with 92 µm porous carbon buffer + 38 µm inner pyrolytic carbon + 33 µm silicon carbide barrier + 41 µm outer pyrolytic carbon to give < 1mm diameter coated particle (image: X-Energy).*

TRISO fuel typically contains HALEU (High Assay Low Enriched Uranium), 5%-20% enriched in the fissile uranium isotope U-235. Natural uranium as mined contains 0.71% U-235, typical large reactors and water cooled SMRs use uranium enriched to <5%.

[1] https://www.energy.gov/ne/articles/trump-administration-pushes-microreactor-test-beds-front-line

[2] https://www.energy.gov/ne/articles/energy-department-announces-first-microreactor-experiments-dome-test-bed

## 5. Heat technology

As an alternative to helium gas for heat transfer from the reactor core, the heat in some designs is transferred from the reactor fuel to the power convertor by heat pipes.

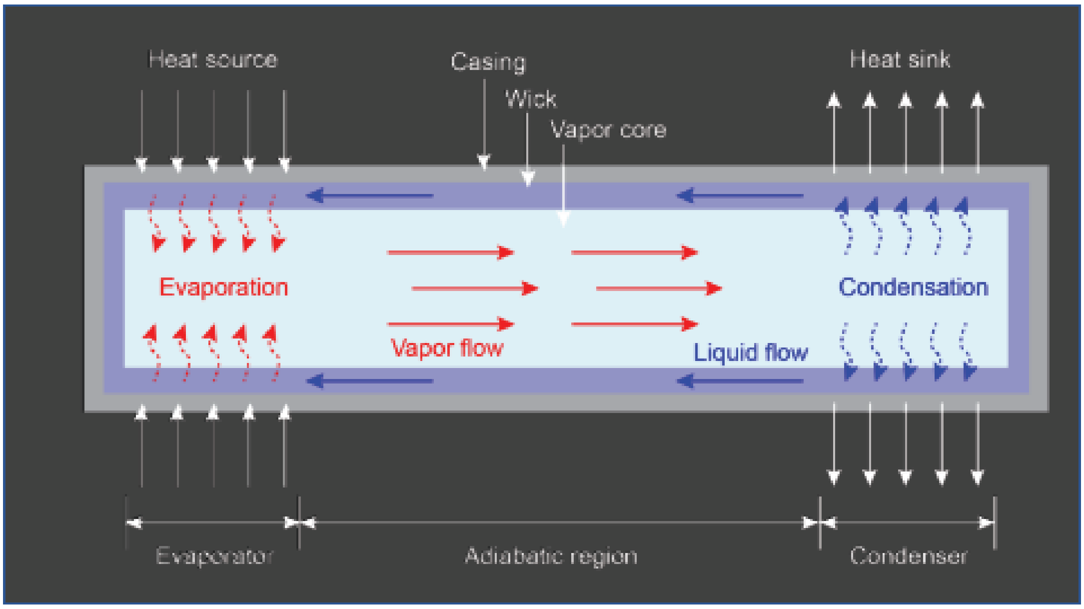



*Image: Oklo*

Heat pipes have been developed since 1994 at the Los Alamos National Laboratory (LANL) as a robust and low technical risk system with no moving parts and an emphasis on high reliability and safety. Originally developed for space applications, heat pipes are used in many microreactors. The heat pipe is filled with sodium or potassium and sealed. The vapor pressure over the hot liquid working fluid at the hot end of the pipe is higher than the equilibrium vapor pressure over the condensing working fluid at the cooler end of the pipe, and this pressure difference drives a rapid mass transfer to the condensing end where the excess vapor condenses, releases its latent heat. The condensed working fluid transfers back to the hot end by capillary action in the wick.

**Advantages of heat pipe technology**:[3]

- Allows for greatly simplified design and eliminates numerous components needed in active systems
- Significantly increases reliability and eliminates failure modes and additional systems associated with active systems
- Eliminates risk from high system pressures and loss of coolant accidents
- Eliminates flow-induced corrosion and vibration, typical of forced flow systems

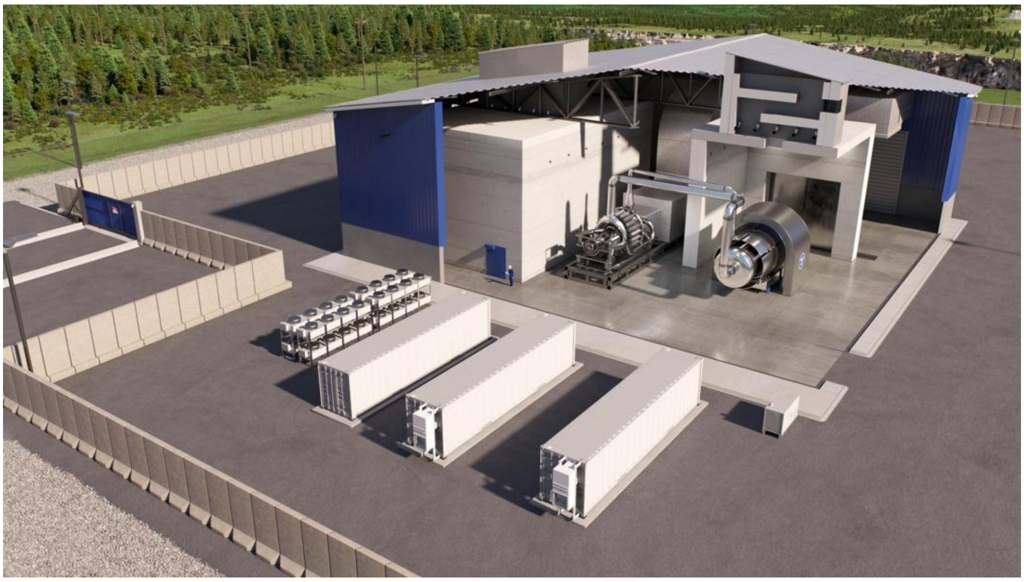
[3] https://westinghousenuclear.com/energy-systems/evinci-microreactor/

# 6. Competing microreactor technologies

## 6.1 Westinghouse eVinci microreactor

Westinghouse have been designing and supplying nuclear reactors since the 1950's. Their current portfolio includes the AP-1000 large nuclear power reactor (3,400 MW thermal, 1250 MW electrical). AP-1000 reactors are operating in China and the USA. In 2023 they launched their SMR version, the AP300 (990 MW thermal, 300 MW electrical). They also have a microreactor size reactor named eVinci[4].

The eVinci microreactor has a nominal capability of 15 MWth / 5 MWe and can deliver 750$^0$C process heat. The plant is fully assembled at the manufacturing facility and arrives on site in three shipping containers – Reactor Container, Power Conversion Container and Instrument & Controls Container - and can be in operation in 30 days on a prepared basemat. Site area less than 1 hectare. It has a design life of 40 years and can be transported to a new site before end-of-life. The reactor is a solid monolithic block with three types of channels accommodating TRISO fuel, neutron moderator and sodium filled heat pipes. The reactor uses no water. The are no moving parts in the primary cooling system. The plant is capable of autonomous operation and remote monitoring. The power conversion is by an air Brayton cycle. Refuelling every 8 or more full power years.



*A feasibility study by Bruce Power and Westinghouse in 2021 found that the EVinci microreactor could provide cost-effective energy to off-grid markets in Canada.[5]*

[4] https://westinghousenuclear.com/energy-systems/evinci-microreactor/

[5] https://www.brucepower.com/wp-content/uploads/2021/10/210283A_WestinghouseBPMicroReactor_ExecutiveSummary_R000.pdf

*Image: Westinghouse*

Westinghouse is progressing towards commercial deployment:

- 2023, Westinghouse announced an agreement to locate an eVinci microreactor in Saskatchewan, Canada.[6] Westinghouse began the Vendor Design Review process with the Canadian Nuclear Safety Commission (CNSC) in June 2023.
- September 2024 – Westinghouse completed the front-end engineering and experiment design (FEEED) process to test a prototype eVinci at INL.
- December 2024, the NRC approved the reactor's advanced logic system instrument and control platform, making it the first microreactor with an NRC-approved I&C system.
- March 2025, Westinghouse and Urenco signed a fuel enrichment agreement under which Urenco will provide HALEU for the eVinci reactor for five years.
- March 2025, Pennsylvania State University initiated the application process to the NRC to construct an eVinci at a new research facility at its University Park campus.
- 1 July 2025 – DOE selected Westinghouse as one of the two companies to perform the first microreactor test in DOME.

## 6.2 Radiant Industries (Kaleidos MMR)

Radiant[7] is a company based in El Segundo, California founded in 2019 by former Space X engineers. Radiant has been developing a 1.9 MW thermal, 1.2 MWe HTGR design (named Kaleidos) using TRISO fuel, helium coolant and a graphite moderator. The power generator, reactor, cooling system and shielding are all packaged in a single shipping container facilitating rapid deployment. Supercritical $CO_2$ power conversion. No site excavation is required, Kaleidos is lowered from the truck and achieves full power within 48 hours. The entire container can be shipped back for refuelling every five years. Kaleidos can be refuelled a total of 4 times for a 20-year product lifetime. Radiant is targeting commercial unit production in 2028. Kaleidos are assembled, fuelled and tested in the factory. The

[6] https://info.westinghousenuclear.com/news/first-canadian-evinci-microreactor-targeted-for-saskatchewan

[7] https://www.radiantnuclear.com/

container can be separated into *Reactor and Shielding* and *Turbomachinery and Cooling* for flexibility in transport and maintenance.


**Radiant Kaleidos microreactor**

- February 2023, Radiant received a Gateway for Accelerated Innovation in Nuclear (GAIN) award from the US DOE to work with Argonne National Laboratory (ANL) on heat production and removal from their microreactor.
- Nov 2024 – Radiant completed the front-end engineering and experiment design (FEEED) phase to test a prototype at INL.[8]
- 1 July 2025 – DOE selected Radiant as one of the two companies to perform the first microreactor test in DOME.
- 8 July 2025 – Radiant signed an agreement with the Defense Innovation Unit (DIU), Department of the Air Force under the Advanced Nuclear Power for Installations (ANPI) program to deliver Kaleidos to the Air Force within three years[9].
- Aug 2025 – Data centre developer and operator Equinix signed pre-order agreement for 20 Radiant Kaleidos

## 6.3 BWX Technologies (USA) BANR microreactor

BWXT has 75 years' experience of nuclear technology in the USA, they have manufactured all the reactors for US naval propulsion.

BANR (BWXT Advanced Nuclear Reactor) is a TRISO-fueled High Temperature Gas Reactor (HTGR), graphite moderated, 50 MW thermal power scalable and is designed to be transportable in five ISO-compliant CONEX shipping containers. The fuel is 19.75% HALEU, with +5 years refuelling. BANR is designed with inherent and passive safety features.

- December 2020 – BWXT was one of five companies selected by the US DOE to

[8] https://www.energy.gov/ne/articles/radiant-completes-study-first-kaleidos-microreactor-experiment

[9] https://www.radiantnuclear.com/blog/diu/

receive a share of USD 30 million in initial funding for risk reduction projects under its Advanced Reactor Demonstration Program (ARDP)
- 2021 - BWXT received an award of $111m over 7 years from the US DOE under the ARDP.
- September 2023 - In order to focus the design on a particular need, BWXT signed a 2 phase, 2-year contract with Wyoming Energy Authority (WEA). Phase 1 objective is to tailor the BANR design and commercial development plan to meet the needs of Wyoming, particularly trona (soda ash) mining. Phase 1 of the WEA project is scheduled to be completed in May 2024.
- September 2023 - BWXT signed a co-operation agreement with Tata Chemicals to assess the viability of deploying BANR for their soda ash manufacturing operations in phase 2.
- June 2024 – Phase 2 awarded, includes conceptual design of a lead microreactor unit, developing a regulatory plan and microreactor fleet model.
- December 2024 – Tata chemicals signed a letter of intent to explore the deployment of up to eight BANRs for electricity and industrial processing at a soda ash site in Green River, Wyoming.

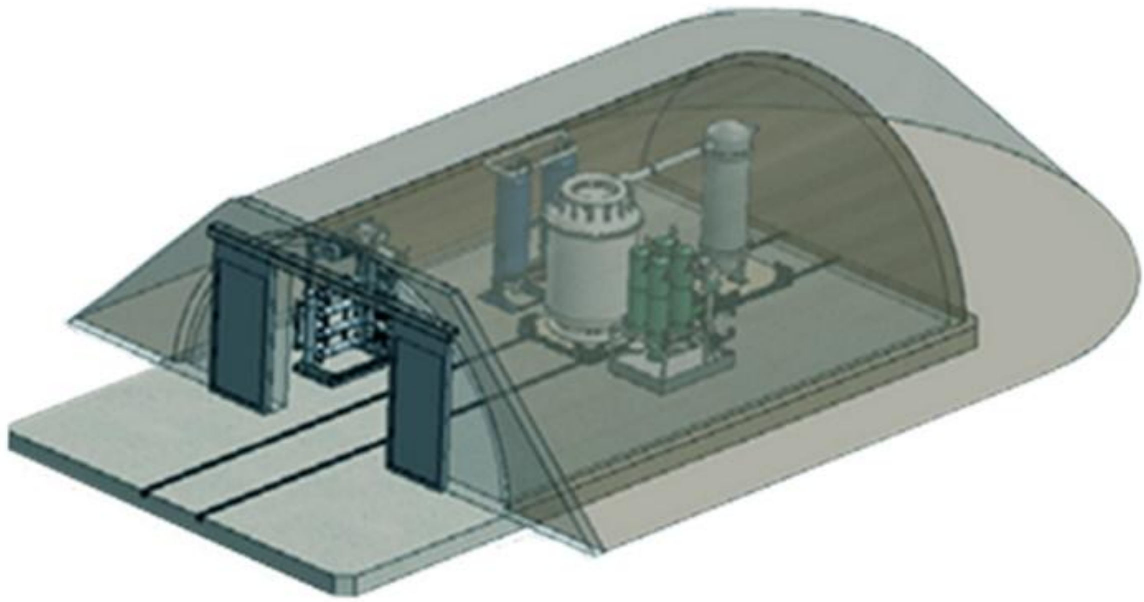


*Image :BWXT BANR*

**Project Pele – mobile microreactor for the US Department of Defence (DoD)**
Project Pele was launched in 2019 with the objective to design, build and demonstrate a prototype mobile nuclear reactor within 5 years. The initiative is led by DOD's Strategic Capabilities Office (SCO). The reactor will be tested and operated under DOE authorisation.

- March 2020 the US Department of Defence (DOD) awarded contracts, under Project Pele, to three companies, including BWXT, to begin design work on a mobile microreactor prototype. The DOD uses around 30 TWh/year of electricity and 10 million gallons of fuel per day. The entire reactor system is designed to be assembled on-site and operational within 72 hours.
- June 2022 - the DoD awarded a contract to BWXT to complete and deliver the prototype 1.5 Mwe full-scale transportable microreactor to the Idaho National

Laboratory (INL) site for testing. The fuelled reactor was scheduled to be operating in 2025.
- September 2024 – DoD broke ground at INL's Critical Infrastructure Test Range Complex, concrete shield structure to be ready for reactor placement by 2026.
- July 2025 – fabrication of the reactor core began at BWXT Technologies Innovation Campus in Lynchburg, Virginia. BWXT owns and operates the only privately-owned facilities in the USA licensed to possess HEU for down-blending into HALEU. BWXT has completed fabricating the TRISO nuclear fuel for the reactor and will soon ship it to INL. Rolls-Royce is developing the power conversion module at its Liberty Works facility in Indianapolis.

## 6.4 Aurora Powerhouse Oklo (USA)

Oklo is a 4 MWt/1.5 MWe sodium cooled fast reactor, based on the US EBR II reactor that operated for thirty years. The primary cooling system uses heat pipes to transport heat from the metal fuel in the reactor core to a supercritical carbon dioxide power conversion system to generate electricity. The reactor can operate for up to 10 years before refuelling.

- 2016 - Oklo began formal pre-application engagement with the NRC.[10]
- 2017 – fuel prototyped
- 2018 – Thermal testing at Sandia National Lab
- 2019 – DOE issues Oklo a site use permit at INL and awards fuel material
- 2020 - Oklo submitted the first ever advanced fission licence application to construct and operate (Combined licence under 10 CFR Part 52) a plant up to 15 MWe. Application not accepted as insufficient information provided.
- May 2023, Oklo and the Southern Ohio Diversification Initiative (SODI) signed an agreement to host two plants in Southern Ohio, up to 30 MWe and 50 MW heat.
- August 2023, Oklo signed an MOU with Centrus (the US enrichment company) to support deployment of Oklo in Southern Ohio. Oklo would purchase HALEU from the planned Centrus production facility in Piketon, Ohio and Centrus would purchase electricity from the planned Oklo reactors on the Piketon site.
- April 2024 – Oklo signed letters of intent for long-term power purchase agreements with Diamondback Energy for its oil and gas production facilities and with Equinix to serve its data centres in the USA.
- Dec 2024 – Oklo and Switch, a data centre development company, signed a collaboration agreement for Oklo to construct and operate Aurora Powerhouses to provide up to 12 GWe of power to Switch.
- January 2025 – Oklo signed a MOU with RPower, a leading provider of onsite prime and backup power solutions to deploy a phased power model for data centres. The model combines immediate energy deployment using RPower natural gas generators with a transition path to Oklo's Aurora Powerhouses.[11]
- May 2025 – Oklo successfully completed borehole drilling for site characterisation at the INL site of the first Aurora Powerhouse

[10] https://www.nrc.gov/reactors/new-reactors/advanced/who-were-working-with/licensing-activities/pre-application-activities/okla-aurora-powerhouse.html

[11] https://oklo.com/newsroom/news-details/2025/Oklo-and-RPower-Join-Forces-to-Accelerate-Power-Availability-for-Data-Centers/default.aspx

- June 2025 – US Defense Logistics Agency Energy on behalf of the US Department of Air Force issued a notice of intent to award Oklo a contract to deploy an Aurora Powerhouse at Eielson Air Force Base in Alaska. Oklo would design, construct, own and operate the plant.[12] Completion target 2030.
- July 2025 – Oko announced successful completion of US NRC's pre-application readiness assessment for Phase 1 of the COLA for Oklo's first commercial Aurora powerhouse at INL. Phase 1 application in 2025.

*Aurora Powerhouse Image: Oklo*

## 6.5 Nano Nuclear Energy

Nano Nuclear Energy[13], established by entrepreneur Jay jiang Yu and now a publicly listed company, is developing the KRONOS MMR Energy System, a stationary HTGR with molten salt thermal storage.
Nano is also developing ZEUS, a solid-core battery reactor and ODIN, a low pressure coolant reactor using natural convection. Zeus and Odin will use HALEU, are modular and designed to be easily transportable, in standard shipping containers.

The KRONOS MMR design was acquired by Nano in January 2025 following the bankruptcy of the Ultra Safe Nuclear Corporation (USNC). This microreactor is a high temperature gas cooled reactor with a 10 - 45 MW thermal output and an electrical output of 3.3 MWe -15 MWe using TRISO fuel in prismatic graphite blocks and helium coolant.

[12] https://oklo.com/newsroom/news-details/2025/Oklo-Selected-as-Intended-Awardee-to-Provide-Clean-Reliable-Power-to-Eielson-Air-Force-Base-in-Alaska/default.aspx

[13] https://nanonuclearenergy.com/

Image:Nano

The nuclear plant will supply 45 MWt of process heat to an adjacent non-nuclear plant by an intermediate molten salt heat exchanger. The heat can be used as process heat and to generate electricity. The design has a service life of 40 years and includes facilities for periodic refuelling on site. On site construction time is 18 months. The reactor can be ramped from idle 5% power to 100% in minutes.
Global First Power (GFP) was a joint venture between USNC and Ontario Power Generation (OPG) to site a demonstration MMR at the Canada National Laboratory Chalk River site. Pending Canadian governmental approvals of the acquisition by Nano, this demonstration project is still expected to take place at the Chalk River site. The KRONOS MMR was the first SMR to enter the Canadian Nuclear Safety Commission's formal licensing review and has completed Phase 1.

USNC also had a project to deploy their MMR in the USA as a research reactor at the University of Illinois Urbane-Champaign. Nano has extended this existing collaboration and signed a new agreement in April 2025[14]. Nano will also continue the MMR licensing process with the NRC.

In July 2023, USNC and its partner Jacobs was awarded USD29m though the UK Advanced Modular Reactor Research, Development and Demonstration program, with the aim of a USNC demonstration HTGR operating in the UK by the early 2030's.

**Zeus Microreactor**
Zeus is a solid-core battery reactor with a fully sealed core that uses a highly conductive moderator matrix to dissipate fission heat. There is no fluid in the core. All reactor and support systems fit in a standard shipping container. Power conversion uses an open-air

[14] https://nanonuclearenergy.com/nano-nuclear-and-university-of-illinois-urbana-champaign-sign-landmark-agreement-to-build-the-first-kronos-mmr-research-reactor/

Brayton cycle. The Zeus core is designed to provide constant power for at least 10 full power years.

*ZEUS microreactor – image Nano Nuclear Energy Inc*

- August 2024 – NANO signed a MOU with the Rwanda Atomic Energy Board that could lead to the deployment of SMRs and MMRs in the African nation
- March 2025 – NANO assembled the first reactor core hardware of ZEUS for initial non-nuclear testing.

**Odin Microreactor 5 MWth**

[15]Odin uses uranium hydride fuel with up to 20% enrichment. The low-pressure salt coolant operates at 400°C. Annular Linear Induction Pump (ALIP) Technology, based on electromagnetic (rather than mechanical) pumps is a key enabling technology for the Odin MMR. Forced circulation of coolant at normal operation allows a substantial increase in core power density, while improving reliability and reducing maintenance requirements.

- Jan 2025 – Nano announced that it had contracted Thermal Engineering International to support design and fabrication of heat exchangers for ODIN.

[15] https://nanonuclearenergy.com/odin/


**Odin image: NANO**

**Pylon Microreactor (now rebranded as the LOKI MMR)[16]**
The acquisition from USNC also included the Pylon Transportable Reactor Platform. The Pylon microreactor is a containerised system capable of producing 1.5-5 MWe with a lower mass than the MMR high-temperature gas-cooled reactor system, designed to be easily transportable to off-grid locations both on Earth and in space. Pylon shares a technology base with KRONOS. Core outlet temperature 727$^{o}$C, TRISO prismatic fuel. Pylon was one of three microreactors selected in 2023 to receive a share of USD3.9 million of federal funding for front-end engineering and experiment design in the Demonstration of Microreactor Experiments (DOME) test bed facility at Idaho National Laboratory, and NANO said it will continue efforts to demonstrate the reactor at DOME by 2027.

## 7 US Department of Defense

On 10$^{th}$ April 2025 the US Defense Innovation Unit (DIU), with the Department of the Army and the Department of the Air Force, launched the *Advanced Nuclear Power for Installations* (ANPI) program.[17] First announced in summer 2024, the program will allow for the design and build of fixed on-site microreactor nuclear power systems on select military installations to support global operations across land, air, sea, space, and cyberspace. The Department of

[16] https://nanonuclearenergy.com/nano-nuclear-energy-announces-loki-mmr-as-the-new-tradename-for-its-newly-acquired-patented-pylon-transportable-reactor-platform/

[17] https://www.diu.mil/latest/DOD-selects-eligible-companies-for-the-Advanced-Nuclear-Power-for-Installations-Program

Defense team selected eight companies to be eligible to demonstrate the ability to deliver compliant, safe, secure, and reliable nuclear power.

The companies are now eligible to receive Other Transaction (OT) awards to provide commercially available dual use microreactor technology at various DOD installations. Selected companies for the ANPI program include:

- Antares Nuclear, Inc
- BWXT Advanced Technologies LLC
- General Atomics Electromagnetic Systems
- Kairos Power, LLC
- Oklo Inc
- Radiant Industries Incorporated
- Westinghouse Government Services
- X-Energy, LLC

ANPI objectives include deploying a decentralised scalable microreactor system capable of providing enough electrical power to meet 100% of all critical loads.
The DoD could jump-start the civilian nuclear industry by procuring and de-risking advanced nuclear technologies.

## 8 Cost competitiveness of microreactors

A 2019 report[18] by the Nuclear Energy Institute examined the predicted costs of stationary microreactors in the USA. They found that microreactors can be cost competitive for remote locations such as off-grid communities, mine sites, islands and defence installations.
NEI estimated the cost to generate electricity from the first microreactors will be between USD 0.14/kWh and USD 0.41/kWh. As companies continue to produce microreactors, future costs are estimated to fall to between USD 0.09/kWh and USD 0.33/kWh. The range of costs are due to variations in transport accessibility, site conditions, the technology, the ability to reduce costs through learning, and the type of owner. NEI estimated the cost of diesel generation to be between USD 0.15/kWh and USD 0.60/kWh. (21-86 Australian c/kWh at 0.7 rate)

A feasibility report[19] prepared by Bruce Power and Westinghouse examined the deployment of the eVinci microreactor in mining and remote communities in Canada. There are over 100 remote communities in the Canadian north consuming about 900 million litres of diesel fuel per year. The Natural Resources Canada SMR roadmap identified 24 mines with demands in the range 5 – 20 MW and about 15 new mines are built per year. Westinghouse estimate the LCOE for an eVinci microreactor as $290/MWh. In Canada, the cost of diesel in remote areas is $310-500 /MWh

[18] https://www.nei.org/CorporateSite/media/filefolder/resources/reports-and-briefs/Report-Cost-Competitiveness-of-Micro-Reactors-for-Remote-Markets.pdf

[19] https://www.brucepower.com/wp-content/uploads/2021/10/210283A_WestinghouseBPMicroReactor_ExecutiveSummary_R000.pdf?__hstc=253552982.5a4af200646ada7106dcbeb2d2216c7c.1715908649356.1715908649356.1715908649356.1&__hssc=253552982.1.1716082368650&__hsfp=628108955&hsCtaTracking=82b3789e-0ccc-43a2-8656-d0a3acbcae6c%7Ca84e469e-5007-43d4-8f4e-eb5d07de4a84

A large (1 MW) diesel generator fuel consumption is ~ 0.27 l/kWh[20]. Currently in Australia (July 2025) the wholesale cost of diesel is 169-187 c/litre[21] depending on location. This equates to a diesel generation cost of 46 – 51 c/kWh.

In addition to the fuel cost, the economic costs of diesel generation would also have to take into account the Operations and Maintenance (O&M) cost and the diesel lifetime. O&M costs per kWh decrease with increasing unit size. For a 1 MW diesel generator, O&M costs are in the range 14-25c/kWh[22].

In Australia, a microreactor will need to compete with the 60 – 76 c/kWh cost of fuel and O&M for a large diesel generator. The eVinci microreactor estimated LCOE is USD290/MWh which at an exchange rate of 0.7 = A$414/MWh = 41.4c/kWh.

**If the estimated LCOE is achieved, then the eVinci microreactor will be very competitive with diesel in off-grid situations in Australia, so will also other microreactor designs.**

Diesel costs are higher in remote communities as the cost of fuel transportation is significant and in some times of the year can be very difficult. Governments generally subsidise these costs to reduce the economic burden on communities. Also, for mining industries, fuel and transport costs are a significant part of production costs.

Deployment of microreactors would enable government subsidies to be reduced and would reduce the electricity costs for industrial users.

Some mine sites only operate for 10 years. A microreactor can be taken away and redeployed on another site.

## 9 Microreactors for Mining

OECD-NEA report 7686 (Sept 2024) "*SMRs for Mining – Opportunities and Challenges"* [23] includes MMRs for off-grid mining activities. Off-grid mining is expensive, mainly due to the high costs of generating electricity in a remote area (>20km from a grid supply). The NEA report found that while 16% of mineral deposits were found in remote areas, only 5% of existing mining operations operate in remote areas. NEA analysis projects a growing need for off-grid mining due to increased demand for critical minerals required for the clean energy transition. Some critical minerals, such as rare earth elements, niobium, lithium and cobalt, are more commonly found in these remote areas. NEA found that predicted costs of MMR's appear to be competitive with existing diesel generation in remote areas. NEA also found that an alternative solution of extending transmission lines to serve a remote mine site has a very significant capital cost. The mine lifetime is also an important consideration as an MMR can be easily relocated but a transmission line could not be easily re-routed.

[20] https://www.generatorsource.com/Diesel_Fuel_Consumption.aspx

[21] https://www.unitedpetroleum.com.au/list-pricing/

[22] https://www.researchgate.net/figure/Operations-and-maintenance-costs-per-kWh-from-calculated-models-and-RCA-data-According_fig2_321687684

[23] https://www.oecd-nea.org/jcms/pl_96131/smrs-for-mining-opportunities-and-challenges-for-small-modular-reactors

Currently there are projects in Russia to deploy MMRs at remote mine sites including the Cape Naglounyn project for the Baimskaya copper and gold mine (Russian artic) and Seligdar's Kyuchus gold deposit in Yakutia. A Shelf-M 10 MWe MMR will supply a new mine at the Sovinoye gold deposit (Chukotka) and also provide power for local communities. The *Akademik Lomonosov* 70 MWe (two reactors on a barge) floating nuclear power plant has been supplying electricity and heat to the gold, silver and copper mines and the local community at Pevek, the most northern city in Russia since 2019.

## 10 OECD NEA Small Modular Reactor Dashboard[24]

The third edition of this very useful publication was released in July 2025. It includes microreactors and provides an assessment of each reactors progress to deployment against metrics of licensing, siting, financing, supply chain, engagement and fuel, based on a cut-off date of 14 February 2025.

## 11 Summary of key conclusions

- Microreactors are a reliable, flexible source of electricity generation, independent of the weather.
- Microreactors will be an economic option to replace diesel fuel to supply electricity, heat and other energy needs for remote communities, islands and mine sites in Australia.
- Microreactors reduce carbon emissions. There are no emissions during operations and the whole of life emissions are similar to inshore wind and less than solar.
- The deployment of microreactors will reduce the need for government subsidies for diesel for remote communities.

## 12 About SMR Nuclear Technology Pty Ltd

SMR Nuclear Technology Pty Ltd (SMR-NT) is an independent Australian-owned specialist consulting company.

SMR-NT was established in 2012 to advise on and facilitate the siting, development and operation of safe nuclear power generation technologies.



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[24] https://www.oecd-nea.org/jcms/pl_108326/the-nea-small-modular-reactor-dashboard-third-edition?details=true