

The title 'ADVANCED NUCLEAR REACTOR TECHNOLOGY' is centered in the lower right quadrant of the page. It is written in a white, all-caps, sans-serif font. A thin yellow horizontal line is positioned directly below the title.

ADVANCED
NUCLEAR
REACTOR
TECHNOLOGY

A COMPANY
COMPENDIUM

JULY 2023 UPDATE

ADVANCED NUCLEAR REACTOR TECHNOLOGY

A COMPANY COMPENDIUM



nuclearinnovationalliance.org

July 2023

PHOTO CREDITS

Cover:
X-energy

Other images:

ARC Clean Energy, BWXT, GE-Hitachi, General Atomics, Holtec, International Atomic Energy Agency, Kairos Power, NuScale Power, Nuclear Innovation Alliance, Oklo, TerraPower, Terrestrial Energy, Ultra Safe Nuclear Corporation, Westinghouse, X-energy.

FOR MORE INFORMATION

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Introduction:

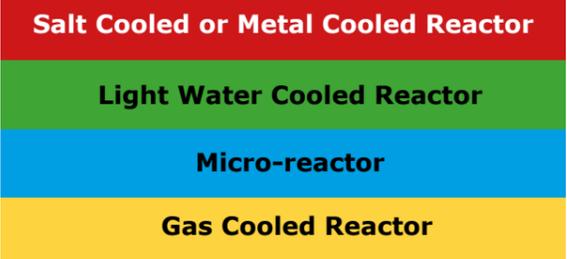
Advanced nuclear energy companies are completing development activities for new nuclear reactors and beginning construction and deployment in the United States and Canada. While there is significant overlap in the needs of advanced and conventional nuclear reactors, each advanced reactor will require new supply chains. Some advanced nuclear power plants will have similar power conversion systems but others will require new structures, systems, and components that differ from existing large light water reactors. Clear understanding of the design and the future supply chains for different advanced reactor companies enable more effective engagement and investment in advanced nuclear energy.

This compendium highlights major advanced reactor developers and their current development and deployment status, and documents public agreements between advanced reactor companies and outside parties including the private sector, government, universities, and international organizations. The compendium is a broad summary of the advanced reactor business ecosystem and provides insight into what companies are associated with the planning, design, testing, construction, and operation of advanced nuclear energy projects. This compendium was created using publicly available information as of July 2023.

This compendium is sorted by advanced reactor company and highlights their major projects. The compendium also includes brief information about the advanced nuclear fuel cycle here in the United States and Canada. For detailed information about each reactor design and other advanced nuclear energy technologies, see NIA's report, [Advanced Nuclear Reactor Technology: A Primer](#), to see the differences between conventional nuclear reactors and advanced nuclear reactors, as well as the differences among advanced reactor technologies themselves.



Nuclear Energy Supply Chain
Source: IAEA



*Quick Reference Guide for Company
Reactor Technology Type*

NA
NUCLEAR
INNOVATION
ALLIANCE

Reactor Types

Thermal Fission

- Advanced Light-Water Reactors**
Evolutionary design from existing reactors with inherent safety features
- High-temperature reactors (HTRs)**
High temperatures drive high efficiency, well-suited for process heat or hydrogen production. Uses TRISO fuel
- Molten Salt-Fueled Reactors (MSRs)**
Using molten salt for coolant and a fuel form, MSRs can bring significant safety benefits

Thermal or Fast Fission

- Gas-cooled fast reactor (GFR)**
An evolution of HTRs, GFRs operate at very high temperatures while using a more sustainable fuel cycle

Fast Fission

- Sodium-cooled fast reactor (SFR)**
With many existing experimental reactors, SFRs offer increased fuel efficiency, reduced waste, and passive safety features
- Lead-cooled Fast Reactor (LFR)**
Similar in design to SFRs, LFRs are advantageous as lead is operationally safer than sodium

Quick Reference Guide on Advanced Reactor Technology Types
Source: NIA



ARC Clean Technology

Partners

Major Project

Canadian Commercial Reactor: [ARC-100](#);
United States' Advanced Reactor Development Project (ARDP) ARC 20 Project: [First-Of-A-Kind \(FOAK\) Reactor](#)

Major Project Description

Small Modular Sodium Fast Reactor

Project Location or Headquarters

HQ: Washington, DC
Project Location: ARC-100 Commercial Demonstration: New Brunswick, Canada; ARDP ARC20 FOAK: TBD, USA

Government Funding Status

US\$27.5 million awarded by US DOE ARDP ARC 20 Program; CAD30 million awarded by Province of New Brunswick, Canada

Nuclear Regulatory Commission (NRC) and Canadian Nuclear Safety Commission (CNSC) Licensing Status

NRC: Preapplication Interaction

CNSC: VDR Phase 1 complete, VDR Phase 2 in progress. License to prepare site application submitted in 2023.

Expected Deployment

Point Lepreau Demonstration: 2029
Port of Bellendune Project: TBD

Utility Partners

[New Brunswick Power \(NB Power\)](#)

New Brunswick, Canada
New Brunswick Power Corporation, operating as NB Power, is the primary electric utility in the Canadian province of New Brunswick. NB Power is a vertically-integrated Crown Corporation wholly owned by the Government of New Brunswick and is responsible for the generation, transmission, and distribution of electricity

Technology Partner

[GE-Hitachi](#)

Wilmington, NC
GE Hitachi Nuclear Energy is a provider of advanced reactors and nuclear services with deep experience in sodium cooled reactors.

Industry Partners

[Hatch](#)

Mississauga, ON, Canada..... (905) 855-7600
Hatch is a leading Canadian engineering firm with extensive history in energy project design and execution and will design ARC's power plants in a fully digital format.

[United Engineers & Constructors](#)

Mount Laurel, NJ..... (844) 860-0504
United is a leading infrastructure engineering, procurement, construction, and consulting company.

Industry Partners (continued)

Kinectrics

Toronto, Ontario..... (416) 207-6000
Kinectrics is an integrated life cycle management services company providing testing, inspection, certification and engineering consulting for the electric power generation, transmission and distribution markets worldwide. ARC Clean Energy and Kinectrics will collaborate on regulatory affairs, safety analysis, and licensing support.

IHI Corporation

Tokyo, Japan..... +81 36-204-7800
IHI is a Japanese engineering corporation that produces and offers plant engineering and industrial machinery.

Cross River Infrastructure Partners

Greenwich, CT..... (203) 340-5750
Cross River will help ARC Clean Energy develop sustainable industrial projects globally that employ ARC Clean Energy’s advanced Small Modular Reactor (SMR) technology.

Belledune Port Authority

New Brunswick, Canada..... (506) 522-1200
Port of Bellendune is Canada’s Green Energy Hub which is a specialized development district on Port lands welcoming green energy projects and complementary, low-carbon industries

Other Partners (continued)

Argonne National Laboratory (ANL)

Argonne, IL..... (630) 252-2000
ANL is a multidisciplinary science and engineering research center, focused on nationally important energy and environmental research.

Idaho National Laboratory (INL)

Idaho Falls, ID..... (866) 495-7440
INL, a DOE national laboratory, is the nation’s leading center for nuclear energy research and development.

Sandia National Laboratory (Sandia)

Albuquerque, NM..... (505) 844-8066
Sandia is a DOE national science and engineering laboratory focused on national security and technology innovation in support of the U.S. Department of Energy’s National Nuclear Security Administration.

Other Partners (continued)

University of New Brunswick (UNB)

Fredericton, NB, Canada..... (506) 453-4508
UNB offers undergraduate and graduate degrees in more than 60 disciplines and continuing education in a variety of fields. ARC and UNB are collaborating on several projects in support of the commercial deployment of the ARC-100 in New Brunswick.

Canadian Nuclear Laboratories (CNL)

Deep River, ON, Canada..... (613) 584-3311
CNL is Canada’s premier nuclear science and technology organization, and a world leader in developing nuclear technology for peaceful and innovative applications. CNL is focused on restoring and protecting the environment, advancing clean energy technology, and medical breakthroughs continue to improve the health of people around the world. Through a joint agreement signed in July 2022, CNL will deliver a technology demonstration of the fuel fabrication process for ARC’s reactor.

Province of Saskatchewan

Regina, SK, Canada..... (306) 787-2198
The Province of Saskatchewan and the Province of New Brunswick have signed an MOU to enhance collaboration on the development and deployment of ARC’s small modular reactor.

Province of New Brunswick

Fredericton, NB, Canada..... (506) 453-3826
The Province of Saskatchewan and the Province of New Brunswick have signed an MOU to enhance collaboration on the development and deployment of ARC’s small modular reactor.

Invest Alberta

Edmonton, AB, Canada.....
ARC and Invest Alberta Corporation have signed a Memorandum of Understanding (“MOU”) to jointly pursue activities to support commercialization of ARC’s advanced Small Modular Reactor in the province of Alberta.



BWX Technologies

Major Project

BWXT Advanced Nuclear Reactor (BANR)™

Major Project Description

Small Modular High Temperature Gas Reactor

Project Location or Headquarters

HQ: Lynchburg, VA
Project Location: TBD

Government Funding Status

DOE Risk Reduction Award Winner (\$106.6 million)

NRC Licensing Status

QA Topical Report Submitted to the NRC

Expected Deployment

Early 2030s

Partners

Other Partners

Idaho National Laboratory

Idaho Falls, ID..... (866) 495-7440
INL is providing support via irradiation of fuel specimens in the Advanced Test Reactor (ATR) and post-irradiation examinations.

Other Partners (continued)

Oak Ridge National Laboratory (ORNL)

Lemont, IL..... (303) 751-0741
ORNL is providing support via TRISO fuel research and collaborating on developing new ways to manufacture and qualify parts and materials for high-temperature reactor applications.

BWX Technologies

Major Project

Project Pele™

Major Project Description

Transportable High Temperature Gas Micro-reactor

Project Location or Headquarters

HQ: Lynchburg, VA
Project Location: Lynchburg, VA*
Reactor Site: Idaho National Laboratory, Idaho Falls, ID

Government Funding Status

DOD-SCO Project Pele Winner (\$300 million)

NRC Licensing Status

None - DOE authorization; NRC observing

Expected Deployment

2025

*A majority of the work and reactor assembly on Project Pele will be performed in Lynchburg. The microreactor will then be shipped to INL.

Partners

Industry Partners

[Northrop Grumman](#)

Falls Church, VA..... (703)-280-2900
Northrop Grumman Corporation is an American multinational aerospace and defense technology company.

[Rolls-Royce LibertyWorks](#)

Indianapolis, IN..... (317) 230-2000
Rolls-Royce is a leading manufacturer of highly-efficient integrated power and propulsion solutions. Their power systems are used in aerospace, naval marine, energy and off-highway applications.

[Torch Technologies, Inc.](#)

Huntsville, AL..... (256) 319-6000
Torch Technologies provides research, development, and engineering services to the Federal Government and Department of Defense.

Other Partners

[Idaho National Laboratory](#)

Idaho Falls, ID..... (866) 495-7440
Under a \$37 million award from the Idaho National Laboratory (INL), BWXT will manufacture a core for Project Pele, TRISO fuel for additional reactors and coated particle fuel for NASA. INL administers the contract and provides the technical support and oversight. Fuel for the reactor will be downblended from U.S. government stockpiles of high-enriched uranium (HEU) to high-assay low-enriched uranium (HALEU) and fabricated into TRISO fuel at the BWXT facility in Lynchburg, Virginia.



GE-Hitachi

Major Project(s)

[BWRX-300](#)

Major Project Description

Small Modular Boiling Water Reactor

Project Location or Headquarters

HQ: Wilmington, NC
Project Location: Toronto, Ontario, Canada and Saskatchewan, Canada;
Clinch River, TN, USA

Government Funding Status

DOE Technology Development Grant
Awardee

NRC and CNSC Licensing Status

NRC: Preapplication Interaction,
Construction Permit Application Expected
FY23

CNSC: VDR Phase 2 in progress, Licence to Construct Application submitted in October 2022, VDR Phase 1 and 2 completed March 2023

Timeline

Darlington, Canada Project Deployment
Expected: 2028

Clinch River, TN Project Deployment Expected: 2032

Partners

Utility Partners

[SaskPower](#)

Regina, SK, Canada..... (306) 536-2886
SaskPower has selected the BWRX-300 for potential deployment in the mid 2030s.

[Ontario Power Generation \(OPG\)](#)

Toronto, ON, Canada..... (416) 592-2555
OPG has selected the BWRX-300 s for the Darlington new nuclear site, and will work with GE Hitachi Nuclear Energy (GEH) to deploy the reactor. Canada's first commercial grid-scale, SMR could be completed as early as Q4 2028. In 2023, TVA, OPG, and SGE announced that they will invest in the development of the BWRX-300 standard design and detailed design for key components, including reactor pressure vessel and internals.

[Tennessee Valley Authority \(TVA\)](#)

Knoxville, TN..... (865) 632-2101
In early 2022, TVA Board Members authorized a New Nuclear Program to explore innovative technologies and the company is currently in discussions with GE-Hitachi to support their BWRX-300 design. In 2023, TVA, OPG, and SGE announced that they will invest in the development of the BWRX-300 standard design and detailed design for key components, including reactor pressure vessel and internals.

Industry Partners (continued)**Hatch**

Mississauga, ON, Canada..... (905) 855-7600
Hatch will deliver engineering, construction, and modularization services as well as the manufacturing of safety-related components. Hatch expects to provide key engineering and project delivery services.

Black and Veatch

Markham, OR, Canada..... (905) 747-8506
Black and Veatch is providing "architectural input" for GE Hitachi's BWRX-300 small modular reactors. GE-Hitachi has also partnered with Overland Contracting (a Black and Veatch company), a full-service engineering, procurement and construction contractor.

Saskatchewan Industrial and Mining Supplier's Association (SIMSA)

Saskatoon, SK, Canada..... (306) 343-0019
GEH SMR Canada and SIMSA agree to collaborate in engaging with local suppliers to maximize the role of the Saskatchewan supply chain in the nuclear energy industry.

Synthos Group

Oświęcim, Poland..... +48 33 844 18 21
In 2019, Synthos Green Energy - part of the Synthos Group - signed a cooperation agreement with GEH for the construction of the BWRX-300 reactor in Poland. In 2023, TVA, OPG, and SGE announced that they will invest in the development of the BWRX-300 standard design and detailed design for key components, including reactor pressure vessel and internals.

Cameco

Saskatoon, SK, Canada..... (306) 956-6294
GE Hitachi Nuclear Energy, Global Nuclear Fuel-Americas, and Cameco have entered into a Memorandum of Understanding to explore several areas of cooperation to advance the commercialization and deployment of BWRX-300 small modular reactors (SMRs) in Canada and around the world. Cameco supplies uranium, uranium refining and conversion services to the nuclear industry worldwide and is a leading manufacturer of fuel assemblies and reactor components for CANDU reactors.

Industry Partners (continued)**AECON Nuclear**

Calgary, AB, Canada..... (519) 740-7477
Aecon Nuclear provides a full spectrum of Engineering, Procurement and Construction (EPC) services, in addition to maintenance and manufacturing services for the nuclear power industry. Per a contract announcement between OPG, GEH, Aecon, and SNC-Lavalin, Aecon will handle all construction services, including project management, construction planning, and execution for the Darlington project.

BWXT Nuclear Energy Canada

Cambridge, ON, Canada..... (717) 235-5469
BWXT NEC has over 60 years of experience in the design and supply of large nuclear vessels and other highly reliable nuclear equipment that is used to fuel, inspect, and refurbish reactors. BWXT Canada was awarded the engineering contract for GE Hitachi's BWRX-300 reactor pressure vessel (RPV) at the Darlington site. Work associated with the contract includes engineering analysis, design support, manufacturing and procurement preparations.

SNC-Lavalin

Montreal, Canada..... (514)-393-1000
Per a contract announcement between OPG, GEH, SNC-Lavalin, and Aecon, SNC-Lavalin will serve as the architect and engineer, providing design, engineering, and procurement support.

Sheffield Forgemasters

Sheffield, UK..... +44 (0)114-244-907
Sheffield Forgemasters have manufactured cast and forged nuclear components for multiple applications since 1950. Through an MOU, GEH and Sheffield Forgemasters agree to discuss how the Sheffield-based company's existing and future capabilities could help meet the potential demands of BWRX-300 deployment.

Fermi Energia

Tallinn, Estonia.....
Fermi Energia is a privately-held company that is introducing a new generation small modular reactor in Estonia to meet the security of supply of Estonian energy and achieve the climate goals. help meet the potential demands of BWRX-300 deployment.



General Atomics

Major Project(s)**Fast Modular Reactor™ (FMR)****Major Project Description**

Small Modular High Temperature Gas Fast Reactor

Project Location or Headquarters

HQ: San Diego, CA

Contact: Ron Faibish, 202-713-8333

Government Funding Status

DOE ARC-20 Award Winner (\$31.1 million)

NRC Licensing Status

Preapplication Interaction

Timeline

Mid-2030s

Partners**Industry Partners****Framatome**

Lynchburg, VA..... (434) 832-3000
Framatome signed an agreement to provide testing and analyses needs. Additionally, Framatome's US engineering team will be responsible for designing several critical structures, systems and components for the FMR



Holtec International

Major Project(s)

[SMR-160™](#)

Major Project Description

Small Modular Pressurized Water Reactor

Project Location or Headquarters

HQ: Camden, NJ

Project Location: Oyster Creek Nuclear Site, NJ

Government Funding Status

DOE Risk Reduction Award Winner (\$147.5 million)

NRC and CNSC Licensing Status

NRC: Preapplication Engagement

CNSC: VDR Phase 1 complete, VDR Phase 2 expected

Timeline

Not publicly available

Partners

Utility Partners

[Entergy](#)

New Orleans, LA..... (800)-368-3749
Entergy will evaluate the feasibility of deploying one or more SMR-160s on one or more of its existing sites within the Entergy service area.

[Energoatom](#)

Kyiv, Ukraine.....
The National Nuclear Energy Generating Company of Ukraine (Energoatom) is the Ukrainian state operator for the country's four nuclear power stations. "Energoatom" and Holtec International have signed a Cooperation Agreement that envisions building the first SMR-160 Pilot Project by March 2029.

[ČEZ Group](#)

Prague, CZ..... +420 211-041-111
ČEZ currently operates two nuclear power plants in the Czech Republic, with nuclear power generating roughly one third of all electricity in the country. Holtec and ČEZ Group have an MOU to develop the division of responsibilities for procurement, construction, and commissioning of SMR-160 plants in Czech Republic in accordance with Czech Codes and Standards and inclusion of Czech content in the delivery of the projects. The Parties will also develop a cost estimate for deployment of the SMR-160 standard design in the Czech Republic.

Industry Partners

[Mitsubishi Electric Power Products](#)

Warrendale, PA..... (724) 772-2555
Mitsubishi will design and engineer the digital instrumentation and control systems (I&C) for Holtec's SMR-160.

[Kiewit](#)

Kansas City, KS..... (312) 269-2000
Kiewit has signed an agreement to construct the SMR-160 in North America under a carefully delineated work plan and will lead SMR-160 construction projects internationally.

[ÚJV Řež](#)

Husinec, Czech Republic... +420 266 172 000
This partnership will provide for technical exchange and cooperation, focusing on the licensing pathway and project assessment for SMR-160.

[Škoda Praha](#)

Prague, Czech Republic.... +420 211 045 242
Through this partnership Holtec and Skoda Praha will develop the division of responsibilities for procurement, construction, and commissioning of SMR-160 plants in Czech Republic in accordance with Czech Codes and Standards. They will also develop a cost estimate for deployment of the SMR-160 standard design in the Czech Republic.

[Moorside Clean Energy Hub](#)

White Haven, England
Holtec has joined a consortium with [15 major companies](#) to establish the Moorside Clean Energy Hub in North West England. At the center of the Hub's plan is a number of nuclear projects at Moorside, including a new UK-EPR pressurized water reactor together with potentially a batch of small modular reactors and other innovative technologies.

[North American ForgeMasters \(NAF\)](#)

New Castle, PA..... (724) 658-4703
North American Forgemasters (NAF) is a 50-50 joint venture between [Scot Forge](#) and [Ellwood Group, Inc.](#) NAF will provide the large component forgings for SMR-160s.

[Framatome](#)

Lynchburg, VA..... (434) 832-3000
Holtec International has selected Framatome to develop and qualify the SMR-160 PWR fuel design.

Industry Partners (continued)

[Hyundai E&C](#)

Seoul, South Korea..... (822) 2005-0800
Hyundai will complete the Balance-of-Plant (BOP) design for Holtec's SMR-160 SMRs and develop the integrated 3D plant model for construction using HDEC's proven Building Information Modelling (BIM) management process.

Other Partners

[Korea Trade Insurance Corporation \(K-SURE\)](#)

Seoul, South Korea..... (82-2) 399-7441
K-SURE was established with the goal of promoting trade and overseas investment of Korean enterprises and a mission to boost South Korea's national competitiveness. In a joint announcement with KEXIM and Holtec, the partnership made between companies will focus on provide financial backing to SMR-160 projects around the world

[Export-Import Bank of Korea \(KEXIM\)](#)

Seoul, South Korea..... (82-2) 3779-6114
The primary purpose of KEXIM is to support South Korea's export-led economy by providing loans, financing mega projects and thereby facilitating economic cooperation with other countries. In a joint announcement with K-SURE and Holtec, the partnership made between companies will focus on provide financial backing to SMR-160 projects around the world



Kairos Power

Partners

Major Project

Kairos Power Fluoride Salt-Cooled High-Temperature Reactor (KP-FHR)TM

Major Project Description

Molten Salt Cooled (2LiF:BeF₂ aka "Flibe"), TRISO (TRI-structural ISOtropic particle) fueled reactor

Project Location or Headquarters

HQ: Alameda, CA
Project Location (for Hermes demonstration reactor): Oak Ridge, TN

Government Funding Status

DOE Risk Reduction Award Winner - \$629 million cost share agreement, DOE share: \$303 million

NRC Licensing Status

Hermes construction permit application submitted 4Q 2021; CP expected 4Q 2023

Expected Deployment

Hermes Demonstration Reactor: 2026
Hermes 2: Late 2020s

Utility Partners

Tennessee Valley Authority (TVA)

Knoxville, TN..... (865) 632-2101
TVA and Kairos Power have formed a collaborative development agreement to provide defined engineering, operations, and licensing support for the Hermes low-power demonstration reactor.

KP-OMADA Advanced Nuclear Alliance

Kairos Power has assembled leading North American utilities and generating companies to form the Kairos Power Operations, Manufacturing, and Development Alliance (KP-OMADA) - the first modern advanced nuclear consortium in the U.S., which will advise on the development of KP-FHR technology, licensing, manufacturing, construction, and commercialization. Current members include:

- Bruce Power

Tiverton, ON, Canada..... (519) 361-2673
Bruce Power is Canada's only private sector nuclear generator, producing 30% of Ontario's power and employing more than 4,000 people.

Utility Partners (continued)

- Constellation

Baltimore, MD..... (410) 470-9700
Constellation is the United States' leading provider of carbon-free energy powering over 20 million homes.

- Southern Company

Atlanta, GA..... (404) 506-5000
Southern Company is an American gas and electric utility holding company serving 9 million customers through its subsidiaries.

- Tennessee Valley Authority (TVA)

Knoxville, TN..... (865) 632-2101
The largest federally owned utility corporation in the U.S., providing electricity for 153 local power companies serving 10 million people.

Other Partners

Materion Corporation (ARDP Partner)

Mayfield, Ohio..... (216) 486-4200
Kairos Power and Materion Corporation have partnered in a strategic collaboration to develop a reliable and cost-effective supply of salt coolant for high-temperature molten salt reactors. This coolant is a key component of Kairos Power's fluoride salt-cooled, high-temperature reactors (KP-FHR). Under the agreement, Materion supplies beryllium fluoride, expert technical consultation, and key interfaces, as well as operational support for the Kairos Power-designed Molten Salt Purification Plant. Materion is also a partner in the ARDP Risk Reduction award to support construction, operation, and commissioning of Kairos Power's Hermes demonstration reactor. In July 2022, Kairos Power and Materion commissioned their Molten Salt Purification Plant to produce coolant for high-temperature molten salt reactors.

EPRI (ARDP Partner)

Charolotte, NC..... (650) 855-2121
The Electric Power Research Institute (EPRI) is a partner in the ARDP Risk Reduction award to support construction, operation, and commissioning of Kairos Power's Hermes demonstration reactor. EPRI conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally.

Other Partners (continued)

Idaho National Laboratory (ARDP Partner)

Idaho Falls, ID..... (866) 495-7440
INL also partnered with Kairos Power on government contract awards including development of a prototype control room for an advanced reactor, among others.

Argonne National Laboratory

Lemont, IL..... (630) 252-2000
Argonne National Laboratory and Kairos Power have collaborated on multiple government contract awards, including the development of the System Analysis Module (SAM) Reactor Analysis Code to simulate entire nuclear power plants, and the development of an analytical method to detect oxygen impurities in Flibe salt.

Oak Ridge National Laboratory (ARDP Partner)

Oak Ridge, TN..... (865) 576-7658
Sited in Oak Ridge, TN, Hermes will build upon research first pioneered in the lab on molten salts and the TRISO annular pebble fuel form to be used in KP-FHR. ORNL has also partnered with Kairos Power on government contract awards including fabrication and testing of corrosion-resistant alloys for use in molten fluoride salt environments, among others.

Sandia National Laboratory

Albuquerque, NM..... (505) 844-8066
Sandia National Lab and Kairos Power have collaborated on multiple government contract awards including a DOE Advanced Valve Project grant to develop a more reliable, high-temperature molten salt valve that can safely collect, store and transfer extremely hot and corrosive molten salt.

Urenco

Eunice, NM..... (703) 465 8110
Kairos Power has signed a memorandum of understanding (MOU) with Urenco to collaborate on a path forward to securing a HALEU supply for future commercial reactors.

Other Partners (continued)

Canadian Nuclear Laboratories

Deep River, ON, Canada..... (613) 584-3311
Canadian Nuclear Laboratories and Kairos Power collaborated on a grant funded through the Canadian Nuclear Research Initiative (CNRI) to engineer technologies to better separate, analyze and store tritium generated in small modular reactors.

Los Alamos National Laboratory (ARDP Partner)

Los Alamos, NM..... (505) 667-4391
Los Alamos National Lab (LANL) and Kairos Power have collaborated on multiple government contract awards including a study of molten salt as a coolant for advanced nuclear reactors, working together to develop new technologies to study chemical reactions within, and thermophysical properties of, molten fluoride salt. In late 2022, Kairos announced that LANL will produce TRISO fuel pebbles for the Hermes demonstration reactor at Los Alamos' Low Enriched Fuel Fabrication Facility (LEFFF) in New Mexico.



NuScale Power Corp

Major Project(s)

NuScale Power VOYGR™ SMR Power Plant

Major Project Description

Small Modular Integral Pressurized Water Reactor and Power Plant

Project Location or Headquarters

HQ: Portland, OR
Project Location: Idaho National Lab, Idaho Falls, ID (Carbon Free Power Project) and Doicesti, Romania (RoPower Project)

Government Funding Status

DOE cost-shared financial assistance awards of over \$656 million

NRC and CNSC Licensing Status

NRC: Standard Design Certification approved in 2020, Standard Design Approval for updated NuScale Module in progress, and Combined Operating License Application for CFPP facility expected in 2024.

CNSC: VDR Phase 2 in progress

Timeline

CFPP Project Deployment Expected: 2029
RoPower Project Deployment Expected: 2030

Partners

Utility Partners

Utah Associated Municipal Power Systems (UAMPS)

Salt Lake City, UT..... (801) 566-3938
UAMPS is a interlocal agency that provides comprehensive wholesale electric energy services, on a non-profit basis, to community-owned power systems throughout the Intermountain West. UAMPS is spearheading the Carbon Free Power Project (CFPP), which will enable the first NuScale small modular reactor (SMR) power plant to begin operation in Idaho Falls, Idaho by the end of the decade.

Societatea Nationala Nuclearelectrica SA (SNN)

Bucharest, Romania..... +40 21-203-8200
SNN, a Romanian nuclear energy provider and Nova Power & Gas S.A., joined to create RoPower Nuclear S.A., and signed an MOU with NuScale to conduct engineering studies, technical reviews, and licensing and permitting activities at a site in Doicesti, Romania that is the preferred location for the deployment of the first NuScale power plant in Romania. In December 2022, a contract for Front-End Engineering and Design (FEED) work was signed. Phase 1 of the work will define the major site and specific inputs for a VOYGR-6 SMR plant at the Doicesti Power Plant.

Utility Partners (continued)**Associated Electric Cooperation Incorporated (AECI)**

Springfield, MO..... (417) 881-1204
AECI is owned by and provides wholesale power to a system of six regional transmission cooperatives and their 51 local distribution cooperatives, delivering electricity to 2.1 million people in the region. NuScale signed an MOU with AECI to work together to evaluate NuScale's SMR design as a part of AECI's due diligence to explore reliable, responsible sources of energy for potential deployment.

Xcel Energy

Minneapolis, MN..... (800) 481-4700
Xcel Energy, a leading energy utility provider, signed an MOU with NuScale to explore the feasibility of Xcel Energy serving as a preferred partner to provide a suite of operational power plant services to NuScale customers based on Xcel Energy's exceptional nuclear operational management systems.

Kozloduy Nuclear Power Plant - New Build Plc (KNPP-NB)

Kozloduy, Bulgaria..... +359 9-737-2611
The Kozloduy site is home to Bulgaria's only operating nuclear power plants and KNPP-NB is exploring the possibility of deploying advanced nuclear technology at this location. NuScale and KNPP-NB have an MOU to explore deploying NuScale's SMR technology at the Kozloduy site.

ČEZ Group

Prague, CZ..... +420 211-041-111
ČEZ currently operates two nuclear power plants in the Czech Republic, with nuclear power generating roughly one third of all electricity in the country. NuScale and ČEZ Group have an MOU to share nuclear and technical expertise as the two companies examine applications for NuScale's SMR technology.

Energoatom

Kyiv, Ukraine.....+380 44 2777883
The National Nuclear Energy Generating Company of Ukraine (Energoatom) is the Ukrainian state operator for the country's four nuclear power stations. NuScale and Energoatom have an MOU to explore the deployment of NuScale Power plants in Ukraine.

Utility Partners (continued)**Dairyland Power Cooperative**

La Crosse, WI..... (608) 788-4000
Dairyland provides the wholesale electrical requirements for distribution cooperatives and municipal utilities around Wisconsin. NuScale and Dairyland Power have signed an MOU to explore safe, clean, and cost-effective energy solutions for the future.

Indonesia Power

Jakarta, Indonesia..... (62-21) 5267666
Indonesia Power, in collaboration with Fluor and Japan's JGC Corporation, is looking to deploy a 462-megawatt VOYGR-6 SMR power plant, to be located in West Kalimantan. In March 2023, the United States and Indonesia announced a strategic partnership to help Indonesia develop its nuclear clean energy program, supporting Indonesia's interest in deploying SMR technology to meet its energy security and climate goals. Under this engagement, USTDA awarded a grant to Indonesia Power to provide assistance to assess the technical and economic viability of the proposed nuclear power plant.

Industry Partners**Fluor**

Irving, TX..... (469) 398-7000
Fluor is a global engineering, procurement, fabrication, and construction (EPFC) company providing project services for SMR technologies, operations support for existing facilities, and waste management. Fluor is the major investor in NuScale Power and will provide its EPFC expertise and financial strength to support the deployment of NuScale's SMR technology.

Doosan Enerbility

Changwon, South Korea..... +82 55-278-6114
Doosan, a Korean industrial and energy company, commenced its partnership with NuScale in 2019, and has since completed the design for manufacture of the NPM and performed manufacturing trials to reduce schedule risk and increase cost certainty. As of May 2023, Doosan has begun forging the first reactor pressure vessel (RPV) components for NuScale.

Industry Partners**JGC Holdings Corporation**

Yokohama, Japan..... +81 45-682-1111
JGC Holdings Corporation, a holding company of the world's leading EPC contractor group companies headquartered in Japan, will work with NuScale to secure and execute SMR EPC projects on a global basis and intends to seek opportunities in integrating SMRs with renewable energy and non-electricity applications. As part of a commercial relationship with Fluor, JGC provided a \$40 million cash investment in NuScale and will partner with Fluor on the deployment of NuScale power plants.

GS Energy Corporation

Seoul, South Korea..... +82 22-005-0800
GS Energy, a Korean energy services company, will provide a cash investment in NuScale Power and support deployment of NuScale power plants. The two parties will also look to develop regional NuScale power plant service delivery opportunities.

Sargent & Lundy

Chicago, IL..... (312) 269-2000
Sargent & Lundy has experience in power and energy, and has delivered engineering, design, analysis, compliance, and project management services for nuclear power projects since 1954. Sargent & Lundy has made a cash investment in NuScale Power and will provide joint marketing and design services for the deployment of new NuScale power plants worldwide.

Sarens

Rowesville, SC..... (803) 534-1348
Sarens USA will provide both heavy crane supply for construction as well as engineering, and transportation planning, and will be the heavy haul provider that gets the NPM™ from the factory to the first site.

IHI Corporation

Tokyo, Japan..... +81 36-204-7800
IHI Corporation is a Japanese engineering company, with experience in supplying key components for the nuclear industry. IHI made a cash investment in NuScale Power and will be a preferred supplier of certain manufactured components for NuScale power plants globally.

Industry Partners (continued)**Samsung C&T**

Yongin-si, South Korea..... +82 22-145-5114
Samsung C&T is a Korean construction and engineering company under the Samsung Group and has experience in design, materials procurement, and construction for more than 10 nuclear power plants. Samsung C&T has made an equity investment in NuScale Power and will serve as a strategic partner to Fluor for NuScale projects.

BWXT Nuclear Energy Canada

Cambridge, ON, Canada..... (717) 235-5469
BWXT NEC has over 60 years of experience in the design and supply of large nuclear vessels and other highly reliable nuclear equipment that is used to fuel, inspect, and refurbish reactors. NuScale has collaborated with BWXT NEC to evaluate NPM manufacturability and to develop the fabrication process for the NPMs.

Curtiss-Wright Corporation

Davidson, NC..... (704) 869-4600
Curtiss-Wright Corporation is a global provider of highly engineered, technologically advanced products and services. Curtiss-Wright Target Rock is providing design engineering, procurement, fabrication, and testing services for NuScale's Emergency Core Cooling System (ECCS) Valves.

Honeywell

Charlotte, NC..... (877) 841-2840
Honeywell is an American advanced-technology and manufacturing company. Honeywell will be providing digital control systems for the NuScale power plant.

Paragon Energy Solutions

Fort Worth, TX..... (817) 284-0077
Paragon provides supply chain management solutions and manufactures and services safety-related parts and components for the U.S. commercial nuclear industry, including utility companies with nuclear facilities. NuScale selected Paragon Energy Solutions (Rock Creek Innovations) to perform the final design and manufacturing for its Highly Integrated Protection System (HIPS) platform.

Industry Partners (continued)**PaR Systems**

Shoreview, MN..... (801) 464-1320
PaR Systems is a systems engineering firm specializing in automated manufacturing and material handling equipment. NuScale selected PaR Systems to undertake engineering work for the manufacturing of its Reactor Building Crane (RBC).

Prodigy Clean Energy Ltd.

Montreal, QC, Canada
Prodigy Clean Energy is a Canadian marine nuclear power developer specializing in integrating commercial power reactors into stationary-deployed Marine Power Stations. NuScale has an MOU with Prodigy Clean Energy Ltd. and Kinectrics to explore the licensing and deployment of a Prodigy SMR MPS.

Kinectrics

Etobicoke, ON, Canada..... (416) 207-6000
Kinectrics is a leader in providing life cycle management services for the electricity industry. NuScale has an MOU with Prodigy Clean Energy Ltd. and Kinectrics to explore the licensing and deployment of a Prodigy SMR MPS.

KGHM Polska Miedź S.A. (KGHM)

Lubin, Poland..... +48 76-747-82-00
KGHM is a Polish multinational corporation producing copper and silver and is a large industrial energy user. NuScale and KGHM signed an agreement to initiate work towards implementing NuScale SMRs in Poland. In September 2022, an additional agreement was signed to continue supporting KGHM's application to the Polish nuclear regulator.

Habboush Group (HG)

New York, NY..... info@habboushgroup.com
HG is a global private investment group specializing in managing proprietary assets and investments across the capital structure in energy, infrastructure, technology, and real estate sectors. The agreement between NuScale and HG aims to provide integrated capabilities for financing, investment, development, management, and execution of large-scale assets and projects in connection with the global demand for NuScale's clean energy solutions.

Industry Partners (continued)**Jordan Atomic Energy Commission (JAEC)**

Amman, Jordan.....+962 06-200460
JAEC is the government entity that both manages the nuclear program and leads the development and implementation of nuclear strategy in Jordan. NuScale and JAEC are collaborating to conduct a joint feasibility assessment of NuScale's SMR across Jordan.

ARES Corporation

Burlingame, CA..... (650) 401-7100
ARES Corporation, a quantitative risk management firm, secured an equity position in NuScale Power through a strategic partnership agreement in 2012.

ENERCON Services Inc.

Kennesaw, GA..... (770) 919-1930
ENERCON is an engineering, environmental, and technical services company serving the energy industry with particular focus on nuclear power. ENERCON has an equity position in NuScale Power. As part of this agreement, ENERCON utilized its licensing expertise to support the development of the Design Certification Application (DCA).

Precision Custom Components (PCC)

York, PA..... (717) 848-1126
PCC is a manufacturer of custom fabricated pressure vessels, reactors, casks, and heavy walled components requiring highly specialized machining, welding, and/or fabrication. PCC will provide design engineering, procurement, fabrication, and testing services for NPMs and their components.

Sensia

Houston, TX..... (866) 773-6742
Sensia provides measurements solutions and is supporting NuScale with pressure, level, and flow sensor technology development.

Bentley Systems

Exton, PA..... (610) 458-5000
Bentley Systems is an infrastructure engineering software company. Bentley is on the NuScale evaluated supplier list (ESL) and verification testing for AutoPIPE is performed under the Bentley quality assurance (QA) program.

Industry Partners**Ansys**

Canonsburg, PA..... (844) 462-6797
Ansys is the largest engineering simulation company in the world. NuScale has access to the Ansys structures, fluids suites, and high-performance computing solutions. NuScale will leverage Ansys technology to simulate designs for module containment, thermal hydraulics, and structural integrity of reactor power modules.

Aras

Andover, MA.....(978) 806-9400
NuScale uses Aras's Innovator Platform to provide end-to-end solutions to support regulatory standards, configuration best practices and maintenance support for their SMR. NuScale will be the first nuclear power plant to be designed and managed with Aras Product Lifecycle Management (PLM) as the backbone for its single source of data.

Ultra

Round Rock, TX..... (512) 434-2800
Ultra Nuclear Control Systems will serve as the primary supplier for NuScale-related I&C equipment in the U.S at its Texas-based facility.

Framatome

Lynchburg, VA..... (434) 832-3000
Framatome signed an agreement with NuScale to manufacture fuel assemblies for its SMR based on conventional ceramic uranium dioxide fuel and to provide testing and analyses needed for its Nuclear Regulatory Commission design certification application. In December 2022, NuScale and Framatome announced an additional partnership for Framatome to design fuel handling equipment and fuel storage racks.

Other Partners**Japan Bank for International Cooperation (JBIC)**

Tokyo, Japan..... +81 03-5218-3100
JBIC joined Japan NuScale Innovation, LLC (JNI) in making a strategic investment of \$110 million in NuScale through a purchase of equity from Fluor Corporation. This investment in NuScale represents an expansion in U.S.-Japanese cooperation to progress the deployment of advanced nuclear energy

Other Partners (continued)**Export-Import Bank of Korea (KEXIM)**

Seoul, South Korea.....02-3779-6114
KEXIM is the official export credit agency of Korea providing comprehensive export credit and guarantee programs to support Korean enterprises conducting overseas business. In March 2023, KEXIM and NuScale signed an MOU in which they agreed to financial cooperation in support of deploying NuScale VOYGR plants.

State Scientific and Technical Center for Nuclear and Radiation Safety (SSTC NRS)

Kyiv, Ukraine..... +380 (044) 450-05-00
In February 2020, NuScale and the SSTC NRS signed an MOU where both parties will collaborate on the regulatory and design gaps between the U.S. and Ukraine processes for the licensing, construction, and operation of a NuScale SMR power plant in Ukraine.

Nucor Corporation

Charlotte, NC.....(704) 366-7000
Nucor and its affiliates are manufacturers of steel and steel products, with operating facilities in the United States, Canada, and Mexico. Nucor invested \$15 million via a private investment in public equity (PIPE) in NuScale Power. In May 2023, Nucor and NuScale signed an MOU to explore the deployment of SMRs to power Nucor Electric Arc Furnace Steel Mills.

National Technical Systems (NTS)

Calabasas, CA.....(800) 270-2516
NTS has signed a Business Collaboration Agreement to begin development of an Equipment Qualification (EQ) Test Chamber. This technology will allow NuScale to mimic the range of environmental conditions under which NuScale equipment will be subject to under the U.S. Nuclear Regulatory Commission's requirements.

Accelerant Solutions

Maumee, OH.....
.....hello@discoveraccelerant.com
Accelerant Solutions is a U.S.-based centralized nuclear training organization with extensive experience in training, innovation, and compliance in the nuclear industry. NuScale and Accelerant Solutions will develop lesson plans to train plant operators on operating systems, use of operating procedures, and the NuScale control room simulator.



Oklo

Partners

Major Project

Aurora Powerhouse™

Major Project Description

Fast Spectrum Solid Core Microreactor

Project Location or Headquarters

HQ: Santa Clara, CA
Project Location: Idaho National Lab, Idaho Falls, ID

Government Funding Status

ARPA-E ONWARDS, CURIE, and OPEN award winner, DOE TCF award winner, DOE is supplying first core load.

NRC Licensing Status

Combined Operation License (COL) application submitted 2020. Working towards re-submitting its combined license application.

Expected Deployment

INL Demonstration: 2026
SODI Project: Late 2020s

Industry Partners

Deep Isolation

Berkeley, CA..... (415) 915 6505
Through a DOE-ONWARDS award, INL, Deep Isolation, and Oklo will identify transformative pathways to reduce waste material and minimize the need for disposal sites.

Centrus

Maryland, USA..... (301) 564-3200
Oklo Inc and Centrus Energy Corp have signed a non-binding Letter of Intent to cooperate in the deployment of a production facility for high-assay low-enriched uranium (HALEU) to support the commercialization of advanced fission plants, such as Oklo's Aurora.

Compass Mining

Austin, TX..... (888) 871-3071
Oklo announced a 20-year commercial partnership with Compass Mining (Compass), the world's first online marketplace for Bitcoin mining hardware and hosting.

Other Partners

Argonne National Laboratory (ANL)

Lemont, IL..... (630) 252-2000
Awards granted through the ARPA-E ONWARDS and OPEN programs, and the DOE's Technology Commercialization Fund, Oklo and Argonne are partnering on cutting-edge fuel recycling projects, including demonstrating the end-to-end fuel recycling process to develop a secure and economical domestic fuel supply chain for advanced fission.

Idaho National Lab (INL)

Idaho Falls, ID..... (866) 495-7440
DOE-INL has provided Oklo with their first core and Oklo's first Aurora Powerhouse will also be sited at INL.

Southern Ohio Diversification Initiative (SODI)

Piketon, OH..... (740) 897-2122
SODI is an economic development group representing the development of underutilized land and facilities on the Department of Energy's Portsmouth Gaseous Diffusion Plant Site. The agreement between SODI and Oklo will see two commercial Oklo power plants deployed in Southern Ohio by 2028.



TerraPower

Partners

Major Project
Natrium™

Major Project Description
Sodium Fast Reactor

Project Location or Headquarters
HQ: Bellevue, Washington
Demonstration Project Location: Kemmerer, Wyoming

Government Funding Status
DOE Demonstration Award Winner (\$1.25 billion)

NRC Licensing Status
Preapplication Interaction,
Constuction Permit Application Expected FY23.

Timeline
Demonstration Reactor Operation Expected: 2030

Utility Partner
Pacificorp
Portland, OR..... (888) 740-6700
PacifiCorp is an electric power company in the western United States that will be the operator for the Natrium™ project. In March 2023, Pacificorp announced a forecast for two additional Natrium projects are performing site evaluations for an additional 4 plants.

Technology Partner
GE-Hitachi
Wilmington, NC
GE-Hitachi Nuclear Energy is a provider of advanced reactors and nuclear services. TerraPower’s Natrium design is based off TerraPower’s TWR and GE-Hitachi’s PRISM reactor designs and TerraPower will collaborate with GE-Hitachi as a technology partner to build the Natrium™ project.

Industry Partners
Bechtel
Reston, VA..... (571) 392-6300
Bechtel Corporation is an American engineering, procurement, construction, and project management company. TerraPower chose Bechtel as its plant design, licensing, procurement, and construction partner in a

Industry Partners (continued)
Orano Federal Services
Bethesda, MD..... (301) 841-1600
Orano USA is a technology and services provider for decommissioning shutdown nuclear energy facilities, managing used nuclear fuel, conducting federal site clean-up and closure, and the sale of uranium, conversion, and enrichment services to the U.S. commercial and federal markets.

Global Nuclear Fuels Americas, LLC
Wilmington, NC
GNF, a GE-led joint venture, and TerraPower announced an agreement to build the Natrium Fuel Facility. The facility represents an investment of more than \$200M.

Energy Northwest
Richland, WA..... (509) 372-5000
Energy Northwest is a public power joint operating agency in the northwest United States. They will provide licensing and operating experience to the TerraPower-GE Hitachi team to facilitate development of the concept, including the potential for future operation and maintenance of a plant.

Other Partners
Idaho National Laboratory (INL)
Idaho Falls, ID..... (866) 495-7440
INL a DOE national laboratory, is the nation’s leading center for nuclear energy research and development.

Argonne National Laboratory (ANL)
Lemont, IL..... (630) 252-2000
ANL is a science and engineering research national laboratory operated by UChicago Argonne LLC for the United States Department of Energy.

Pacific Northwest National Laboratory (PNNL)
Richland, WA..... (509) 375-2121
Pacific Northwest National Laboratory is one of the United States Department of Energy national laboratories, managed by the Department of Energy’s Office of Science.

Oak Ridge National Laboratory (ORNL)
Oak Ridge, TN..... (865) 576-7658
ORNL is one of the US DOE national laboratories, managed by the DOE Office of Science

Other Partners (continued)
Duke Energy
Charlotte, NC.....
Duke Energy is an electric utility serving more than 8.2 million people. Duke Energy has included advanced nuclear generation in their latest Integrated Resource Plan.

TerraPower

Major Project
Molten Chloride Reactor Experiment™ (MCRE)

Major Project Description
Liquid Fueled Molten Chloride Salt Reactor (with Southern Company as a partner)

Project Location or Headquarters
HQ: Bellevue, Washington
MCRE Project Location: Idaho National Lab, Idaho Falls, Idaho

Government Funding Status
DOE Risk Reduction Award Winner (\$136 million)

NRC Licensing Status
Preapplication Interaction

Timeline
Reactor Operation Expected: 2025

Partners

Utility Partner
Southern Company
Atlanta, GA..... (404) 506-5000
Southern Company is an American gas and electric utility holding company based in the southern United States. Southern Company’s Research and Development branch is also developing low- and no-carbon generation technologies, advancing renewables, energy storage and distributed generation solutions, and modernizing the grid.

Industry Partners
CORE POWER
Washington, DC..... (202) 507-6375
CORE POWER works on the successful deployment of advanced reactor technologies for the maritime industries.

Industry Partners (continued)

Orano Federal Services

Bethesda, MD..... (301) 841-1600
Orano Federal Services is a partner for environmental cleanup and advanced nuclear solutions with a corporate focus on climate change.

3M Company

St. Paul, MN..... (888) 364-3577
3M™ Stable Isotopes are used in a variety of nuclear power plant and research applications, including: reactor criticality control; both wet and dry, spent, and fresh fuel transportation and storage; nuclear waste containment; and neutron radiation control.

Other Partners

Idaho National Laboratory (INL)

Idaho Falls, ID..... (866) 495-7440
Idaho National Laboratory, a DOE national laboratory, is the nation’s leading center for nuclear energy research and development.

Electric Power Research Institute

Charolotte, NC..... (650) 855-2121
The Electric Power Research Institute, Inc., is an American independent, nonprofit organization that conducts research and development related to the generation, delivery, and use of electricity



Terrestrial Energy

Major Project(s)

Integral Molten Salt Reactor™ (IMSR)

Major Project Description

Liquid Fueled, Molten Salt Reactor

Project Location or Headquarters

HQ: Toronto, Ontario, Canada

Government Funding Status

DOE \$3M award to support licensing and commercialization of IMSR

NRC and CNSC Licensing Status

NRC: Preapplication Interaction, Standard Design Approval Application expected FY23

CNSC: VDR Phase 1 complete, VDR Phase 2 in progress

Timeline

2030s

Partners

Industry Partners

Hatch

Dallas, TX..... (972) 457-9006
The agreement with Hatch provides support for engineering, component procurement, project and construction management, and power plant cost estimation relating to the development and construction of an IMSR power plant.

BWXT Canada

Cambridge, ON, Canada..... (717) 235-5469
Terrestrial Energy has signed engineering design contracts with BWXT Canada for steam generators and heat exchangers for use in the IMSR.

Westinghouse

Cranberry, PA..... (717) 235-5469
Westinghouse and the UK National Nuclear Laboratory signed an agreement for nuclear fuel development and supply to advance the industrial scale up and commercial supply of enriched uranium fuel for use in Terrestrial Energy’s IMSR.

Industry Partners (continued)**KBR**

Houston, TX..... (822) 200-5080
KBR, Inc. is a U.S. based company operating in fields of science, technology and engineering. Terrestrial Energy has signed an agreement with KBR to investigate the application of zero-emission thermal energy for hydrogen and ammonia production.

ANSTO Synroc

Melbourne, Australia..... +61 3 8540 4100
ANSTO will provide technical consulting services to Terrestrial Energy for the conditioning of used reactor fuel from the operation of Integral Molten Salt Reactor heat and power plants in Canada, United Kingdom, United States, and other global markets.

L3Harris

Montreal, QC, Canada..... (450) 476-4000
Terrestrial Energy signed a contract with L3Harris to develop an engineering and operator training simulator for the IMSR.

Siemens Energy Canada

Oakville, ON, Canada..... (905) 465-8000
Siemens Energy Canada will manufacture and supply steam turbines and other balance-of-plant equipment, such as transformers, switchgear, and motor drive systems, for the IMSR.

Cameco

Saskatoon, SK, Canada..... (306) 956-6294
Cameco Corporation will examine potential partnership opportunities to deploy the IMSR in North America and worldwide, and will evaluate possible opportunities for the supply of uranium, fuel and other services. As part of these activities, Terrestrial and Cameco will investigate the potential of Cameco's Port Hope uranium conversion facility.

Orano

Saskatoon, SK, Canada..... (306) 343-4500
The agreement with Orano includes uranium enrichment, chemical conversion to IMSR fuel form, its production, transportation, packaging, and logistics. This scope covers analysis for full-scale commercial production and supply of IMSR fuel and applies to major markets for IMSR power plant deployment today, including Canada, the US, the UK, and Japan.

Industry Partners (continued)**ENGIE Laborelec**

Linkebeek, Belgium
ENGIE Laborelec will perform confirmatory electrochemical and thermophysical measurements as well as confirmatory corrosion testing. The tests will be performed under conditions compliant with quality assurance protocols of nuclear codes and standards, as is required to advance a nuclear power plant design through the regulatory process. To perform this wide range of testing, ENGIE Laborelec will work in close collaboration with its partners, John Cockerill, CRM Group and IJCLab-CNRS.

Aecon Group

Calgary, AB, Canada..... (519) 740-7477
Aecon will review Terrestrial Energy's construction costs and schedules for IMSR, as well as undertake constructability, modularization, and supplier assessments for a broad range of activities including plans for site development and heavy civil construction.

KSB Pump

Mississauga, ON, Canada..... (905) 568-9200
KSB Pumps will supply, develop, and manufacture primary pumps.

DLE&C

Seoul, South Korea
KSB Pumps will supply, develop, and manufacture primary pumps.

Other Partners**Argonne National Laboratory (ANL)**

Lemont, IL..... (630) 252-2000
Terrestrial Energy USA, Inc. has extended its testing program at Argonne National Laboratory (ANL) for measurements of fuel salt properties used in the IMSR.

UK Nuclear National Laboratory

Sellafield, UK..... +31 (0)224 56 4950
Westinghouse and the UK National Nuclear Laboratory signed an agreement for nuclear fuel development and supply to advance the industrial scale up and commercial supply of enriched uranium fuel for use in Terrestrial Energy's IMSR.

Other Partners (continued)**First Nations Power Authority (FNPA)**

Regina, SK, Canada..... (408) 621-0337
Terrestrial Energy and First Nations Power Authority (FNPA) have signed a Memorandum of Understanding (MOU) to explore opportunities to build Indigenous capacity for the future advanced small modular reactor (SMR) industry. Potential collaborative activities include the development of skills training, employment and commercial opportunities that could spur multi-generational Indigenous economic wealth.

TerraPraxis

London, UK.....
TerraPraxis and Terrestrial have signed a Letter of Intent (LOI) to cooperate on Repowering Coal. Under development by TerraPraxis, Repowering Coal is a program to standardize and systematize the replacement of coal furnaces at existing coal-fired power plants with high-temperature heat

Canadian Nuclear Laboratories (CNL)

Deep River, ON, Canada..... (613) 584-3311
Terrestrial Energy has completed an evaluation of its Integral Molten Salt Reactor's (IMSR) nuclear material safeguards in collaboration with the Canadian Nuclear Laboratories (CNL) with support from CNL's Canadian Nuclear Research Initiative (CNRI).

Invest Alberta

Edmonton, AB, Canada.....
Terrestrial and Invest Alberta Corporation have signed a Memorandum of Understanding ("MOU") to jointly pursue activities to support commercialization of Terrestrial's IMSR in the province of Alberta.



Ultra Safe Nuclear

Partners

Major Project(s)

Micro Modular Reactor (MMR®)

Major Project Description

Micro High Temperature Gas Reactor

Project Location or Headquarters

HQ: Seattle, WA

Project Location: Chalk River Laboratories, ON, Canada; and University of Illinois, Urbana-Champaign, IL

Government Funding Status

DOE GAIN Voucher Awardee

NRC and CNSC Licensing Status

NRC: Preapplication Engagement

CNSC: VDR Phase 1 complete, VDR Phase 2 in progress, License To Prepare Site submitted in 2021

Timeline

UIUC Project Deployment Expected: 2027
Chalk River National Lab Project
Deployment Expected: 2027

Utility Partners

Ontario Power Generation (OPG)

Toronto, ON, Canada..... (416) 592-2555
OPG has partnered with USNC to create a joint venture called Global First Power (GFP), which will build, own, and operate the Micro Modular Reactor (MMR®) Project at the Chalk River Laboratories site, and is scheduled for operation 2026.

Construction Permit Partner

University of Illinois, Urbana-Champaign

Champaign, IL..... (217) 333-1000
UIUC will apply for a license to construct a research and test reactor facility on the UIUC campus based on USNC's MMR technology.

Industry Partners

Nuclear Research & Consultancy Group (NRG)

Netherlands..... +31 (0)224 56 4950
NRG will implement a program to analyze performance and safety attributes of the company's proprietary Fully Ceramic Micro-encapsulated (FCM™) fuel designed for use in its Micro Modular Reactor (MMR®).

Industry Partners (continued)

Hyundai Engineering Company, Ltd.

Seoul, South Korea..... (822) 2005-0800
Hyundai Engineering announced that it has signed a contract with USNC to provide a detailed design of a micro modular reactor (MMR®) to be built at Chalk River Laboratories. HEC will also support procurement of materials and services to USNC.

Howden

Renfrew, UK

USNC has contracted with UK-based Howden to design a helium circulator for use in the company's Micro-Modular Reactors (MMR®). Ultra Safe Nuclear is investing in submerged helium blowers to maximize heat transfer in the MMR's power plant.

Korea Atomic Energy Research Institute (KAERI)

Daejeon, South Korea..... +82 42868200

This partnership will provide for technical exchange and cooperation. The five-year agreement outlines goals for development of technologies that enhance the USNC Micro-Modular Reactor's (MMR®) ability to produce and deliver carbon-free power, heat, and hydrogen in future MMR installations. This agreement includes investigating applications for the MMR technology in South Korea.

Reed College

Reed, OR..... (503) 771-1112

USNC-Tech and Reed College of Portland, OR have reached an agreement to irradiate material for the company's first-of-its-kind commercial radioisotope heater. The irradiation is an important step in the development of a commercially viable heating solution for space systems.

Synthos Group

Oświęcim, Poland..... +48 33 844 18 21

In November 2020, Synthos signed a cooperation agreement with Ultra Safe Nuclear Corporation (USNC). USNC and Synthos jointly applied to the Polish Ministry of Development for financing from the IPCEI mechanism (Important Projects of Common European Interest) for projects within the scope of the value chain of hydrogen technologies and systems.

Industry Partners (continued)

Urenco

Eunice, NM..... (575) 394-4646
Urenco is an international supplier of enrichment services and fuel cycle products for the civil nuclear industry. Urenco will provide enrichment services as part of the fuel supply program for USNC's Micro-Modular™ Reactor (MMR®).

Framatome

Lynchburg, VA..... (434) 832-3000

Framatome and USNC have signed a non-binding agreement to integrate their complementary resources through a joint venture to bring the MMR to market.

Other Partners

Portland Holdings

Burlington, Canada..... (905) 331-4292

Portland Holdings is a private investment company. Under the terms of the agreement, Portland, its affiliates, and related entities will invest up to US\$350 million in Ultra Safe Nuclear, aiming to bring MMR technology solutions to the Middle East and North Africa (MENA) and the Caribbean regions.

Lappeenranta University of Technology (LUT University)

Lappeenranta, Finland.....
LUT University and USNC have signed an MOU to further examine the deployment of a MMR as a research and test reactor in the city of Lappeenranta at or near the University's campus. If constructed, the reactor will be operated as a training, research and test facility and will connect to the district heating infrastructure of Lappeenranta Energia, the municipally-owned energy company providing carbon-free district heating to the university, city, and surrounding area.

McMaster University

Hamilton, Canada..... (905) 525-9140

Global First Power, McMaster, and USNC have signed a Memorandum of Understanding (MOU) to further examine the feasibility of deploying an MMR at McMaster University or an affiliated site.



Westinghouse

Major Project(s)

eVinci Microreactor™

Major Project Description

Thermal Spectrum TRISO Fueled Heat Pipe Microreactor

Project Location or Headquarters

HQ: Cranberry, PA

Government Funding Status

US: DOE Risk Reduction Award Winner (\$9.3 million)

Canada: C\$27.2 million from the Government of Canada's Strategic Innovation Fund (SIF)

NRC and CNSC Licensing Status

NRC: Preapplication Interaction, Standard Design Certification Application expected FY23

CNSC: VDR Phase 2 Application under development

Timeline

Not publicly available

Partners

Industry Partners

Saskatchewan Research Council (SRC)

Saskatoon, SK, Canada..... (306) 933-5400
Westinghouse and SRC will jointly develop a project to locate an eVinci™ micro-reactor in Saskatchewan for the development and testing of industrial, research, and energy use applications.

Astrobotic Technology

Pittsburgh, PA..... (505) 667-4391
Westinghouse and Astrobotic will explore collaboration on space technology programmes for NASA and the US Department of Defense.

Bruce Power

Tiverton, ON, Canada..... (519) 361-2673
The work between the two companies will focus on furthering the public policy and regulatory framework; assessing the economic, social and environmental contribution of the eVinci technology compared to alternates such as diesel or other fossil fuels; identifying potential industrial applications; and accelerating the roadmap for Canada to host a globally recognized demonstration as part of the federal small modular reactor (SMR) action plan.

Other Partners

Southern Company

Atlanta, GA..... (404) 506-5000
Southern Company is an American gas and electric utility holding company based in the southern United States. Southern Company's Research and Development branch is also developing low- and no-carbon generation technologies, advancing renewables, energy storage and distributed generation solutions, and modernizing the grid.

Idaho National Laboratory (INL)

Idaho Falls, ID..... (866) 495-7440
INL will qualify the fuel and will perform site assessments of the eVinci microreactor design from Westinghouse.

Penn State University

State College, PA..... (814) 865-4700
Penn State and Westinghouse will partner on research and development focused on exploring and applying nuclear engineering and science innovations to societal needs. They will also begin discussions about siting Westinghouse's eVinci™ micro-reactor at University Park.

Los Alamos National Laboratory

Los Alamos, NM..... (505) 667-4391
Westinghouse and LANL are jointly testing eVinci™ heat pipe technology.

West Virginia University

Morgantown, WV..... (304) 293-0111
West Virginia and Westinghouse will partner on research and development focused on exploring and applying nuclear engineering and science innovations to societal needs. They will also begin discussions about siting Westinghouse's eVinci™ micro-reactor at University Park.



X-energy

Major Project
[Xe-100™](#)

Major Project Description
Small Modular High Temperature Gas Reactor

Project Location or Headquarters
HQ: Rockville, MD
Project Location (ARDP): Dow Seadrift, Texas Facility

Government Funding Status
DOE Demonstration Award Winner (\$1.25 billion)

NRC and CNSC Licensing Status
NRC: Preapplication interaction ARDP/Dow construction permit application readiness assessment in Q4 2023, submission in Q1 2024.

CNSC: Combined Phase 1/2 VDR completion in Q3 2023; VDR Phase 3 to follow

Timeline
Demonstration Reactor Operation Expected: 2029

Energy Northwest Deployment Expected: 2030

Partners

Utility Partners
[Energy Northwest](#)
Richland, WA..... (509) 372-5000
Energy Northwest is a public power joint operating agency in the northwest United States. While no longer the site of the Xe-100 ARDP project, Energy Northwest and X-energy announced a Joint Development Agreement in July 2023 with the intent to deploy a multi-unit project at their site by the end of 2030.

[Grant County Public Utility District \(Grant PUD\)](#)
Ephrata, WA..... (509) 766-2505
Grant County PUD, is a public utility district in north central Washington state.

[Ontario Power Generation \(OPG\)](#)
Toronto, ON, Canada..... (416) 592-2555
Under the agreement, X-energy and OPG will pursue opportunities to deploy Xe-100 advanced reactors in Ontario at industrial sites and identify further opportunities throughout Canada.

Industry Partners
[Dow Chemical](#)
Midlands, MA..... (989) 636-1000
X-energy and Dow Chemical have entered a joint development agreement (“JDA”) to demonstrate the first grid-scale advanced nuclear reactor at Dow’s Seadrift, Texas industrial facility as part of ARDP.

Industry Partners (continued)
[Kinectrics](#)
Naperville, IL..... (416) 207-6000
X-energy and Kinectrics will collaborate on regulatory affairs, safety and licensing, and equipment qualification and testing, including the building of the first commercial-scale Helium Test Facilities (“HTF”) in North America. This facility will test and verify performance of critical structures, systems, and components.

[Cavendish Nuclear](#)
Birchwood, UK..... (571) 392-6300
Cavendish Nuclear, part of Babcock International Group, has signed a Memorandum of Understanding (MoU) with X-energy to act as its deployment partner for High Temperature Gas Reactors in the UK.

[Amstead Graphite Material \(AGM\)](#)
Anmoore, WV..... 304-624-1200
AGM and X-energy announced a partnership to establish an integrated domestic supply chain for nuclear-grade graphite to reduce dependence on foreign sources, bolster advanced manufacturing capabilities, and secure the nuclear energy supply chain in the United States.

[BWXT Nuclear](#)
Lynchburg, VA..... (434) 522-3800
BWXT provides a complete range of nuclear components and services, including the manufacturing of nuclear reactor components for U.S. Navy submarines and aircraft carriers and other nuclear and non-nuclear R&D and component production.

[Centrus](#)
Kennewick, WA..... (509) 627-4300
Centrus has helped with the design of X-energy’s TRISO-X Fuel Facility that will be sited in Oak Ridge, TN.

[Joseph Oat Corporation](#)
Camden, NJ..... (571) 392-6300
Joseph Oat is a designer and fabricator of pressure vessels, reactors, columns, heat exchangers, and other specialty items for the chemical, petrochemical, nuclear power, and other commercial industries.

Industry Partners (continued)
[Lehigh Heavy Forge Corporation](#)
Bethlehem, PA..... (603) 601-0450
Lehigh Heavy Forge produces a full range of forgings for the commercial nuclear power industry including: steam generators, pressure vessels, reactor vessels, and storage casks.

[Sargent and Lundy](#)
Chicago, IL..... (312) 269-2000
Sargent & Lundy will provide joint marketing and design services.

[Maryland Energy Administration](#)
Baltimore, MD..... (908) 580-1119
MEA has awarded grants to X-energy and [Frostburg State University](#) to work together to evaluate the economic viability and social-economic advantages of repurposing a specific Maryland coal-fired electric generating facility with X-energy’s Xe-100.

[Zachry Group](#)
San Antonio, TX..... (409) 960-5037
Under the agreement, Zachry will support the design, development and construction of the Xe-100 fleet.

[Day & Zimmermann](#)
Philadelphia, PA..... (717) 391-3160
Under the agreement, will work on a team with Burns & McDonnell to support the design, development and construction of the Xe-100 fleet.

[Burns & McDonnell](#)
Kansas City, Missouri..... (913) 909-1835
Under the agreement, Burns & McDonnell will work on a team with Day & Zimmermann to support the design, development and construction of the Xe-100 fleet.

[Hatch](#)
Dallas, TX..... (972) 457-9006
X-energy signed a collaboration agreement for engineering and project management with Hatch Ltd for projects in Canada and globally.

Other Partners

Oak Ridge National Laboratory

Oak Ridge, TN..... (303) 751-0741
Through an ARC15 awards, X-energy was able to demonstrate a commercial-scale TRISO fuel line at ORNL to demonstrate their fuel technology. Now X-energy will be creating their TRISO-X fuel fabrication facility near ORNL in Oak Ridge, TN.

First Nations Power Authority

Regina, SK, Canada..... (408) 621-0337
X-energy Canada and First Nations Power Authority (FNPA) have signed a Memorandum of Understanding (MOU) to explore opportunities to build Indigenous capacity for the future advanced SMR industry.

Saskatchewan Industrial and Mining Supplier's Association (SIMSA)

Saskatoon, SK, Canada..... (306) 343-0019
X-energy Canada and SIMSA have signed a memorandum of understanding to support the potential deployment of Xe-100 SMRs.

Invest Alberta

Edmonton, AB, Canada.....
X-energy and Invest Alberta Corporation have signed an MOU to jointly pursue activities to support commercialization of ARC's advanced Small Modular Reactor in the province of Alberta.



Major Project

XENITH Microreactor

Major Project Description

Transportable High Temperature Gas Microreactor

Project Location or Headquarters

HQ: Rockville, MD
XENITH Project Location: TBD

Government Funding Status

DOE Industry FOA Winner

NRC Licensing Status

TBD

Timeline

Reactor Operation Expected: TBD

Partners

Industry Partners

Bosal Energy

Lummen, Belgium.....
BOSAL Energy has years of experience in development, testing and production of highly effective heat exchangers. Bosal will provide the conceptual designs of the intermediate heat exchanger.

Calnetix Technologies, LLC

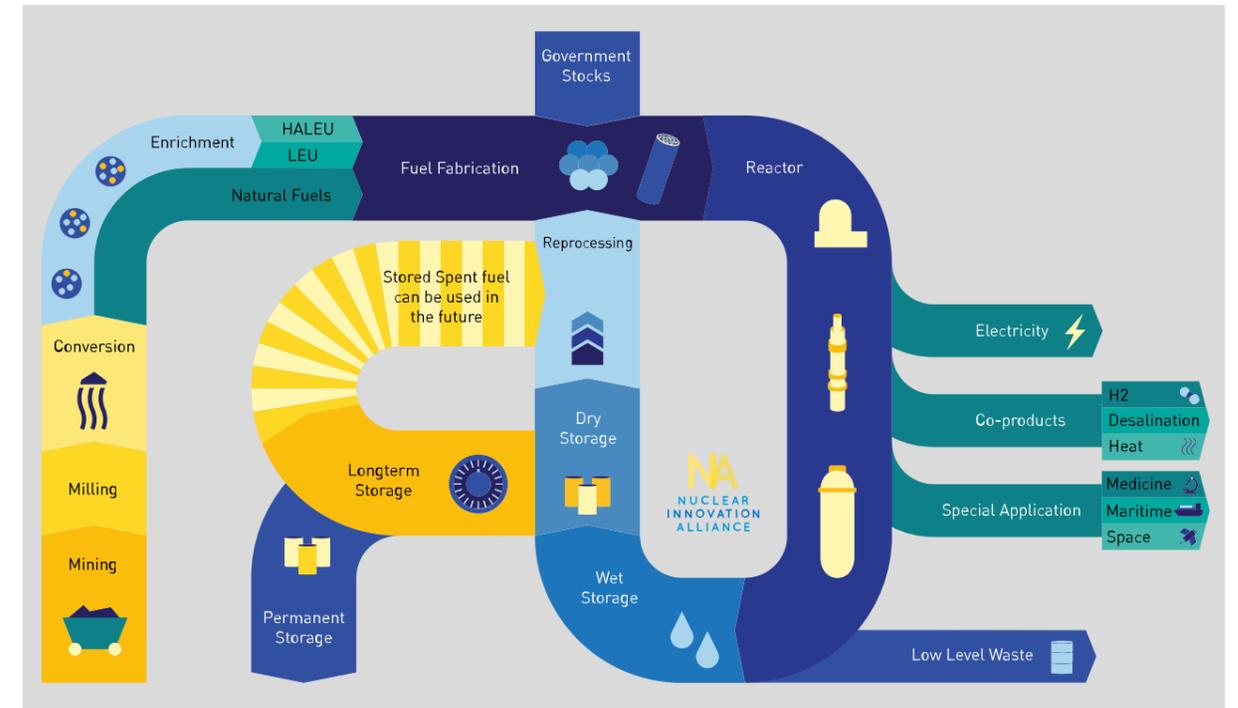
Cerritos, CA..... (562) 293-1160
Calnetix designs, develops and manufactures high-speed permanent magnet motor generators, magnetic bearings systems and power electronics. Calnetix will provide the conceptual designs of the circulator.

Idaho National Laboratory (INL)

Idaho Falls, ID..... (866) 495-7440
INL, who led the ASME BPVC Section 3 Division 5 high temperature materials qualification campaign, provides guidance on integration of these materials into this system, specifically regarding joining and weldment issues.

Oak Ridge National Laboratory (ARDP Partner)

Oak Ridge, TN..... (865) 576-7658
ORNL will apply their SCALE Code System to assess radiation shielding designs for these compact systems.



Fuel for Advanced Nuclear Reactors

Most advanced reactor companies will need to use HALEU fuel for their designs. This requires a mature, commercial HALEU market with adequate conversion, enrichment, and deconversion capabilities to meet fuel fabricator demands. These steps take mined and milled uranium ore and process it into a form that is suitable for use in fuel fabrication processes and eventual use in reactors.

Conversion is the process of taking uranium oxide and then reacting it with fluorine to create uranium hexafluoride gas (UF₆). This gaseous uranium can then be used in different uranium enrichment operations. Conversion is identical for all nuclear reactor fuels, regardless of enrichment level or final fuel form. There is one commercial uranium conversion plant in the United States. The plant is [Honeywell International Inc.](#) and it is located in Metropolis, Illinois. This plant is currently in "idle-ready" status.

Enrichment is the process of raising the concentration of U-235, the fissile isotope of interest for advanced reactor fuels. The primary commercial technology to enrich uranium is gas centrifuge technology. The only gas centrifuge commercial production plant currently operating in the United States is the [URENCO USA \(UUSA\)](#) facility in Eunice, NM

licensed as [Louisiana Energy Services \(LES\)](#). A small scale pilot plant developed and operated by [Centrus](#) was constructed to demonstrate scalable HALEU production. The facility has an initial production capacity of 600 kgU of HALEU per year and is expected to come online in 2023. Uranium enrichment using laser separation technology has been proposed as an alternative to gas centrifuge technology. Commercialization of uranium laser separation technology in the United States has been led by [Global Laser Enrichment \(GLE\)](#). This process has not yet been deployed at a commercial scale for the enrichment of uranium.

Deconversion is the process of taking gaseous UF₆ and chemically processing it into a solid form. These solid forms may include uranium metals, oxides, salts, or other solid forms. The deconversion process can facilitate simpler transportation of HALEU between facilities or prepare HALEU for use in a fuel fabrication process. Different advanced reactor designs will utilize a variety of different deconverted HALEU forms that will vary in both form and final enrichment. Some advanced reactor developers may need additional processing facilities to downblend deconverted HALEU to decrease the concentration of U-235 if HALEU fuel is only enriched to higher than needed concentrations.