



**Pacific
Northwest**
NATIONAL LABORATORY

Nuclear Generation Advances for Power Solutions

Iowa Nuclear Energy Task Force
February 23, 2026

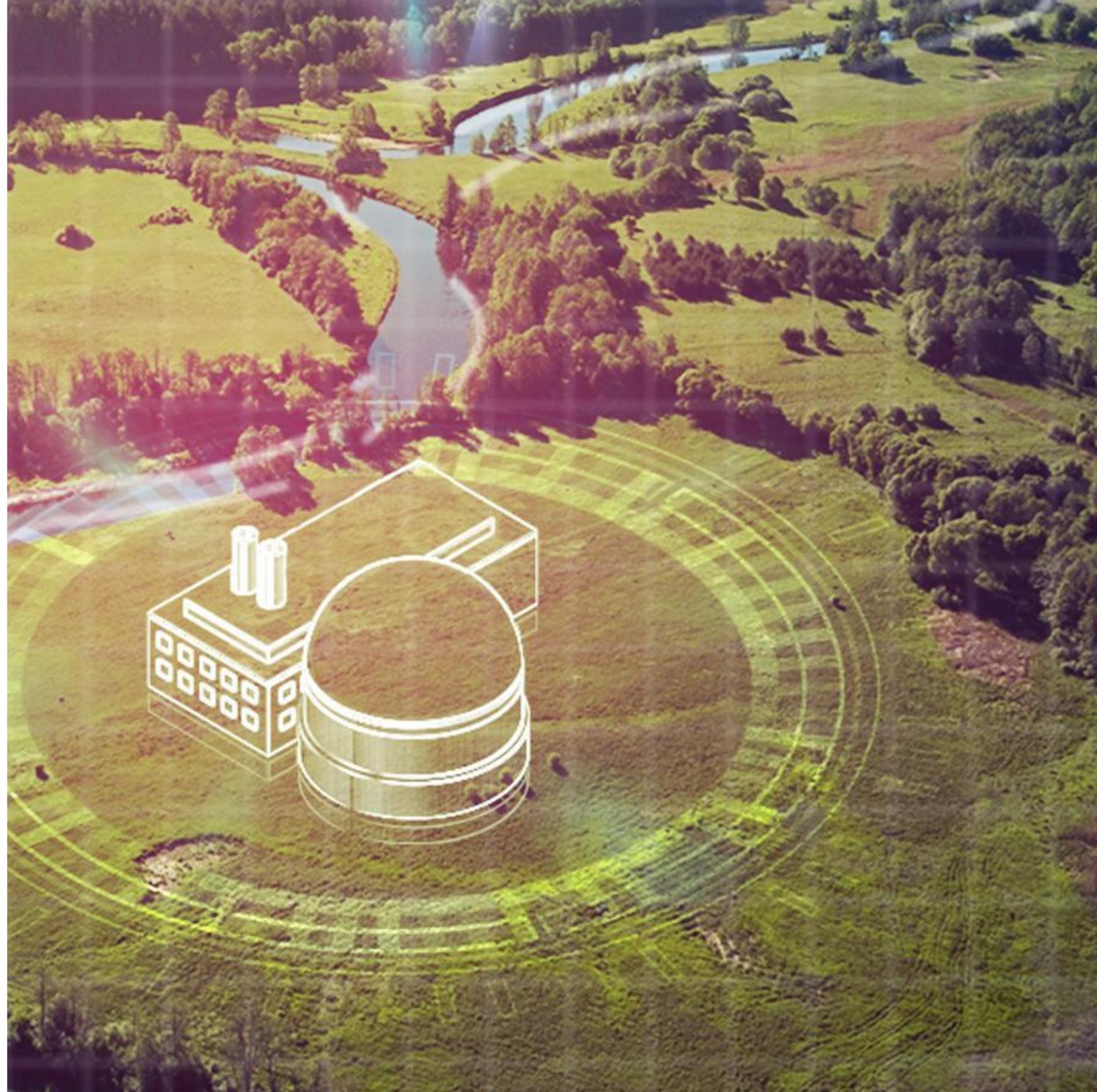
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U.S. DEPARTMENT OF
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PNNL-SA-219776



Level Setting: Intro to New Nuclear

- Intro to Nuclear Technology and Nuclear Taxonomy ✓
- Nuclear Power: Pros and Cons ✓
- Nuclear Operations: Supply Chain, Fuel, and Waste
- Nuclear Safety ✓
- History of Nuclear in Iowa
- State of the Market
 - Federal Policy Rundown ✓
 - State Policy Benchmark
 - Key Players, Key Projects ✓
- Nuclear Power Economics and Risks
- Economic Impact of a Nuclear Reactor
 - Public Opinion, Community Acceptance

Major Pieces Of Legislation Impacting Nuclear Energy Innovation and Investments

- 1. Nuclear Energy Innovation Capabilities Act (NEICA, 2017)**
 - Enable public-private partnerships at DOE labs, established National Reactor Innovation Center, funded advanced reactor licensing
- 2. Nuclear Energy Innovation and Modernization Act (NEIMA, 2019)**
 - Modernize the NRC – streamline advanced reactor licensing, risk-informing, reform fee structure
- 3. Infrastructure Investment and Jobs Act (IIJA, 2021)**
 - Civil Nuclear Credit Program, funded Advanced Reactor Demonstration Program, funding for high-assay low enriched uranium (HALEU)
- 4. Inflation Reduction Act (IRA, 2022)**
 - Significant tax incentives for nuclear energy, existing and new plants
- 5. Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy Act (ADVANCE Act, 2024)**
 - Modernize the NRC (update mission, cost & fee reduction, NRC workforce), extended Price-Anderson Act liability protections



Four executive orders issued on May 23, 2025 establish the Administration's priorities for nuclear energy

Deploying Advanced Nuclear Reactor Technologies for National Security (EO 14299)

- Deploy reactors for national security
- Partnerships with private sector
- Promote U.S. nuclear exports
- Power for critical infrastructure and national security

Ordering the Reform of the Nuclear Regulatory Commission (EO 14300)

- Modernize nuclear regulation
- Realign NRC culture and personnel
- Reform the NRC

Reforming Nuclear Reactor Testing at the Department of Energy (EO 14301)

- Streamline nuclear reactor testing
- Foster nuclear innovation
- Pilot reactor program

Reinvigorating the Nuclear Industrial Base (EO 14302)

- Reinvigorate the nuclear fuel cycle
- Accelerate nuclear energy production
- Expand the U.S. nuclear workforce
- Strengthen domestic fuel supply chain

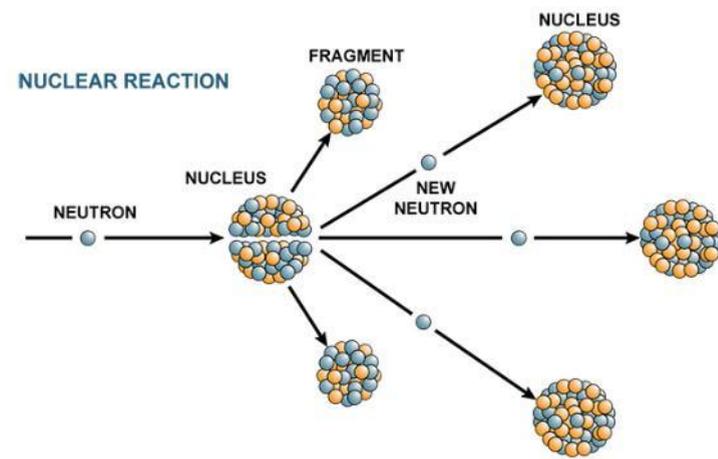
What is driving the **consideration** **(or reconsideration)** of nuclear energy?

- Increased demand ✓
- Resilient energy grids ✓
- Intermittent load balancing ✓
- Firm, reliable generation ✓
- Island mode (data centers) ✓
- Black start capability ✓
- Saturation of renewables ✓
- Carbon-free power laws ✓

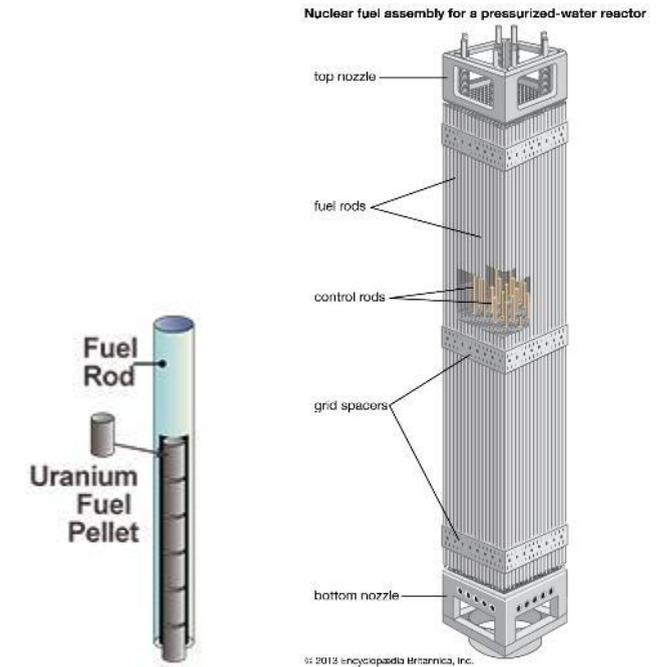


The Science of Nuclear Energy

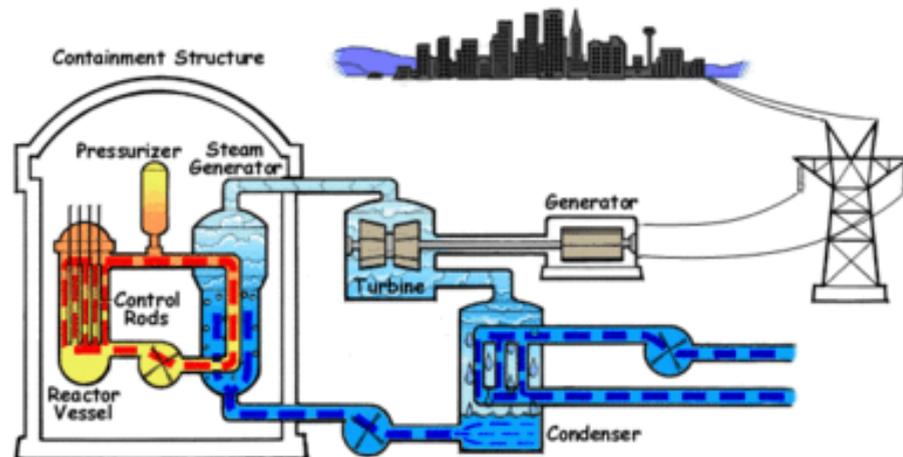
Nuclear Fission



Uranium Fuel

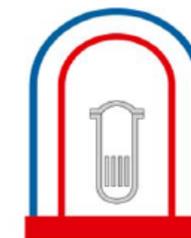
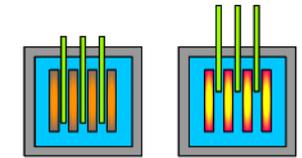


Reactor Power Systems



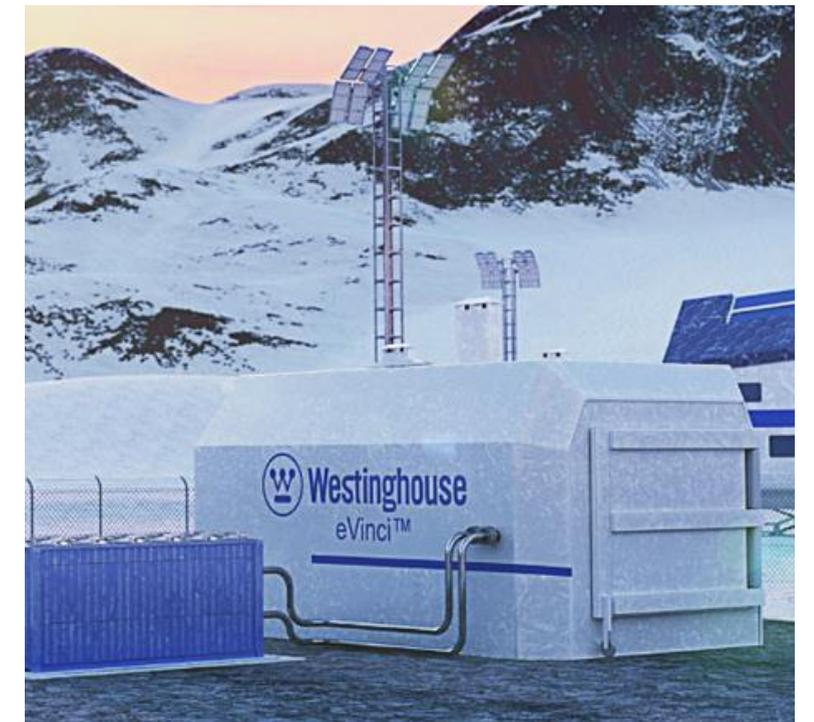
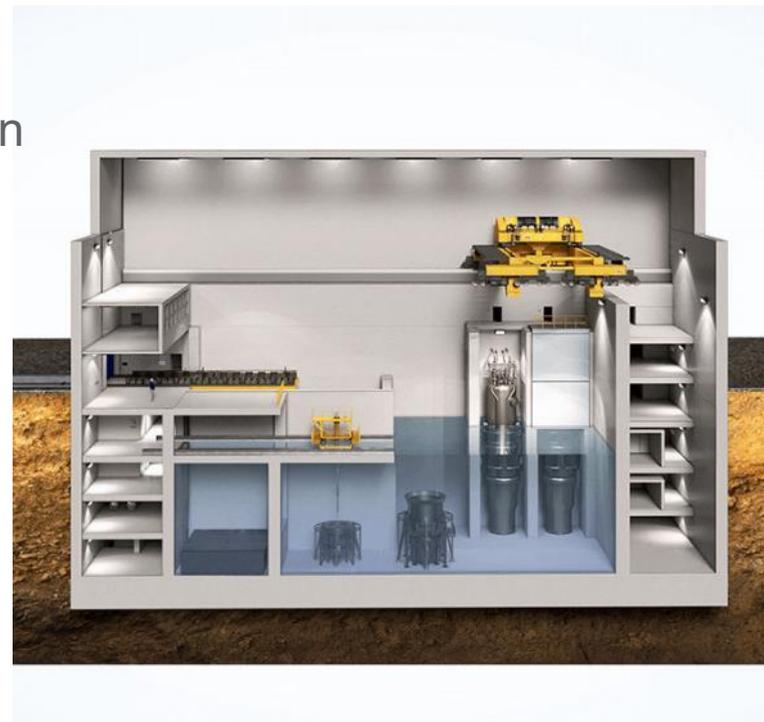
Nuclear Safety

- Reactivity Control
- Heat Removal
- Barriers



Nuclear Evolution

- **Gen I Reactors**
early prototypes
- **Gen II Light Water Reactors (LWRs)**
commercial light water reactors deployed in the U.S.; ~40 year design
- **Gen III Advanced LWRs**
evolutionary design improvements, none deployed in the U.S.; ~60 year design
- **Gen III+ Evolutionary LWRs**
evolutionary Gen III, simplified systems, passive safety: Large LWRs (Vogtle), small modular LWRs (NuScale, GE-Hitachi, Holtec)
- **Gen IV Revolutionary**
advanced fuels, innovative coolants, small modular and micro; high-temperature gas-cooled reactors, sodium-cooled fast reactors, molten-salt reactors.



Active, Inherent, or Passive Safety

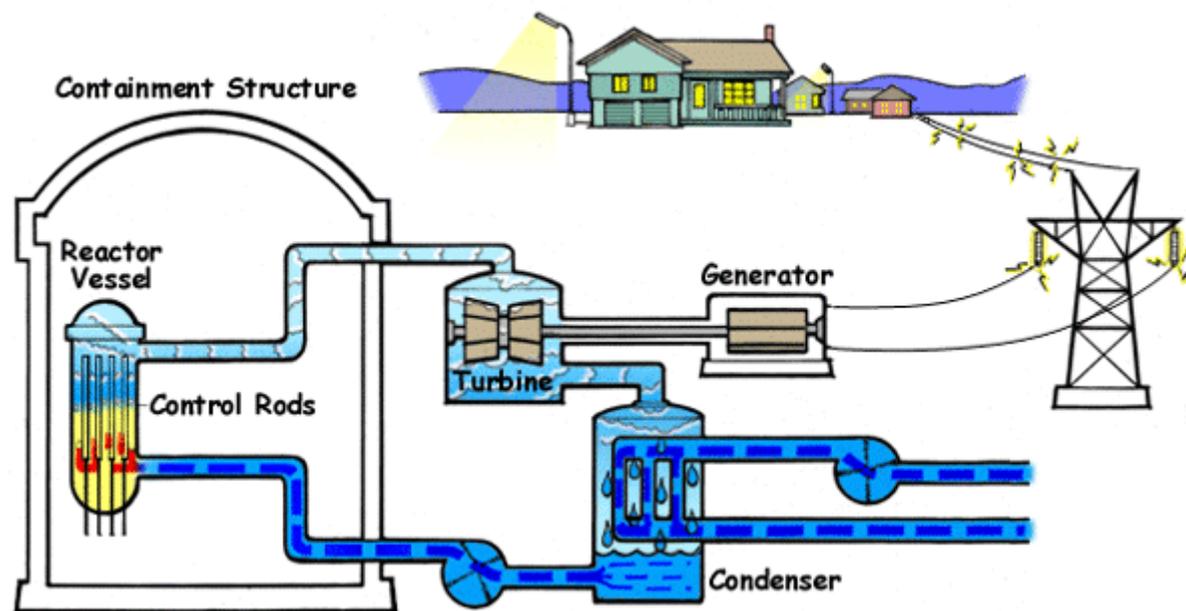
Active	Inherent	Passive
requires an external input to function	rely on fundamental properties or design choices	relies on natural forces, property of materials, or internally stored energy
a valve needs an electrical current to operate or a pump needs electricity to operate	Design achieves reactor shutdown by negative power reactivity feedback (self limiting reaction)	Long term decay heat removal to heat sink using density changes and gravity heads
Current plants	Advanced Reactors (non-light water)	Advanced Reactors (light water and non-light water)



Current Nuclear Power Generation

- + Demonstrated safety
- + 90%+ capacity factor
- + Refueling 18-24 months
- + High reliability
- + Carbon-free
- + Firm, secure power

- Water consumption
- Exclusion zones (footprint)
- High investment cost
- Less agile

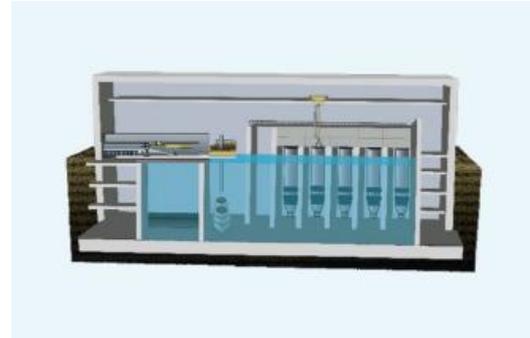


What is an Advanced Nuclear Reactor?



Microreactors
1 MW - 20 MW

mobile, deployable,
small-scale application



Small Modular Reactors (SMRs)
20 MW - 300 MW

scalable, agile operation



Large Reactors
300 MW - 1000+ MW

baseload, large-scale

All Are Advanced Reactors

Advanced Light Water Reactors (Gen III+)

Vogtle Units 3 and 4



Source: <https://www.energy.gov/lpo/vogtle>

NuScale SMR



Source: <https://www.energy.gov/ne/advanced-small-modular-reactors-smrs>

GE Hitachi BWRX-300 SMR



Source: <https://www.energy.gov/ne/advanced-small-modular-reactors-smrs>

Holtec International SMR 160



Source: <https://www.energy.gov/ne/articles/infographic-advanced-reactor-development>

DOE's Advanced Reactor Demonstration Program (Gen IV)

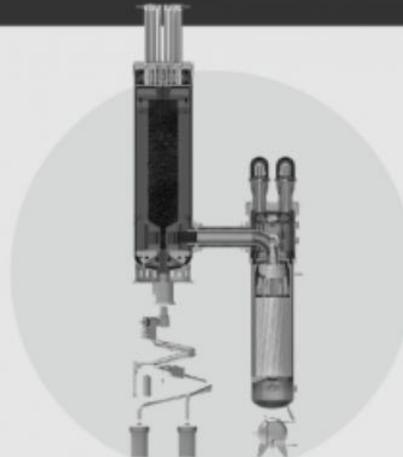
1 DEMONSTRATION

GOAL: Test, license and build operational reactors within 5 - 7 years.



Natrium Reactor

Sodium-cooled fast reactor + molten salt energy storage system
TERRAPOWER

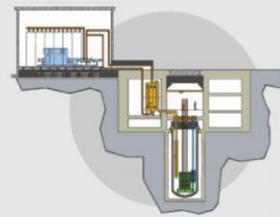


Xe-100

High-temperature gas reactor
X-ENERGY

3 CONCEPT DEVELOPMENT

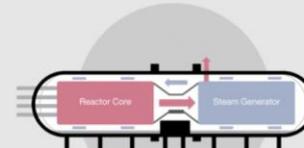
GOAL: Solidify concept to mature technology for potential demonstration by mid-2030s.



Advanced Sodium-Cooled Reactor Facility
ADVANCED REACTOR CONCEPTS



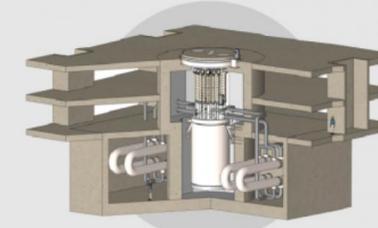
Fast Modular Reactor
GENERAL ATOMICS



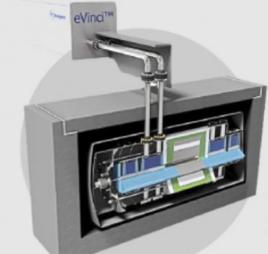
Horizontal Compact High-Temperature Gas Reactor
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

2 RISK REDUCTION

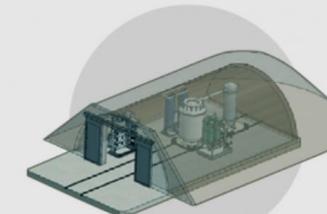
GOAL: Solve technical, operational and regulatory challenges to support demonstration within 10 - 14 years.



KP-FHR
Fluoride salt-cooled high-temperature reactor
KAIROIS POWER



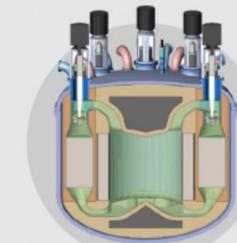
eVinci
Heat pipe-cooled microreactor
WESTINGHOUSE NUCLEAR



BWXT Advanced Nuclear Reactor (BANR)
High-temperature gas-cooled microreactor
BWXT TECHNOLOGIES



SMR-160
Advanced light-water small modular reactor
HOLTEC INTERNATIONAL



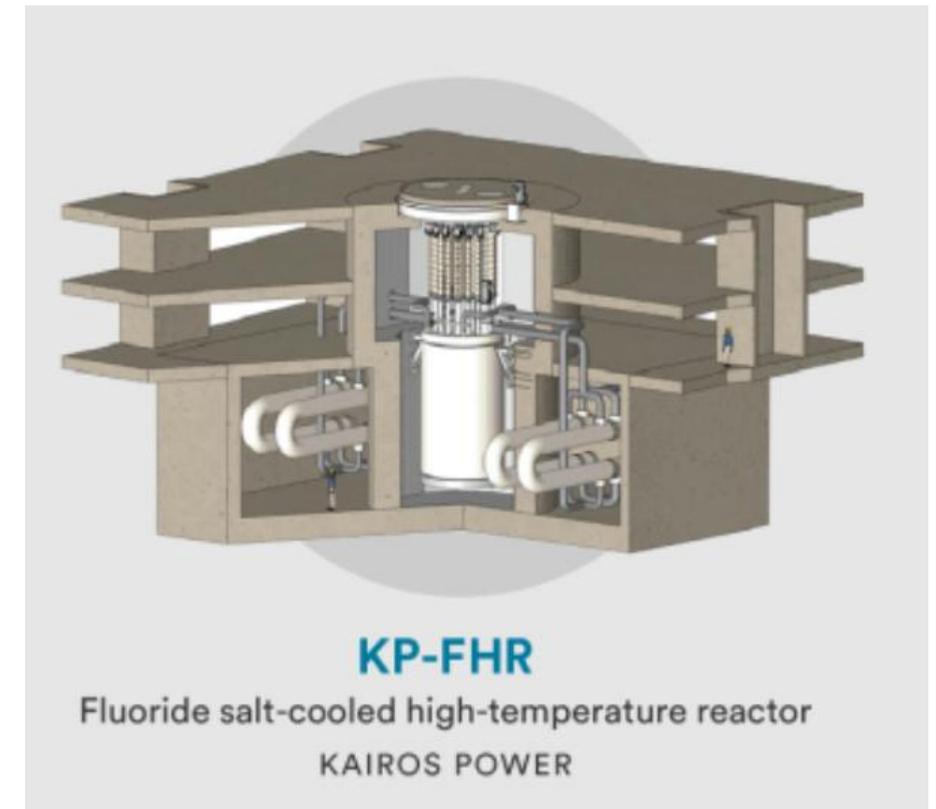
Molten Chloride Fast Reactor
SOUTHERN COMPANY

What are the challenges?

- Capital cost and financing
- Capacity accreditation
- Cost modeling 60-100 year SMR lifespans
- Utility resource action plans favor commercially available technologies
- Dearth in construction of large thermal generation
- Supply chain (fuel)
- Public education and perception

Benefits of Gen IV – Smaller Size

- Modular design
- Factory-built components
- Scalable designs, multiple unit stations
- Underground construction
- Smaller footprint
(20-80 acres vs. 1000 acres)
- Smaller exclusion zones
(0.25 miles vs. 10-50 miles)



Benefits of Gen IV – Versatility

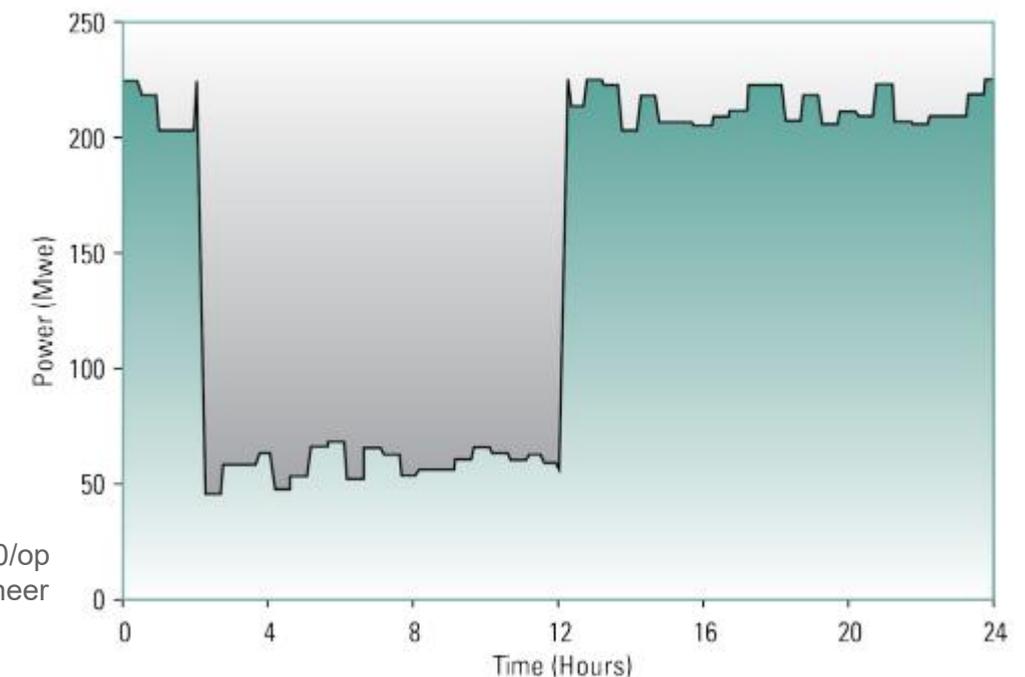
- Flexible operation
- Load follow capability (reactors and/or plants)
- Improved ramp rates (2 - 5 %/min)
- Black start / Island mode
- Shorter refueling
- Less water usage
- More siting options

Sample power change during load follow and frequency control event (Westinghouse SMR)

<https://www.westinghousenuclear.com/Portals/0/operating%20plant%20services/fuel/fuel%20engineering%20services/NF-FE-0040%20SMR%20Operating%20Strategy.pdf>



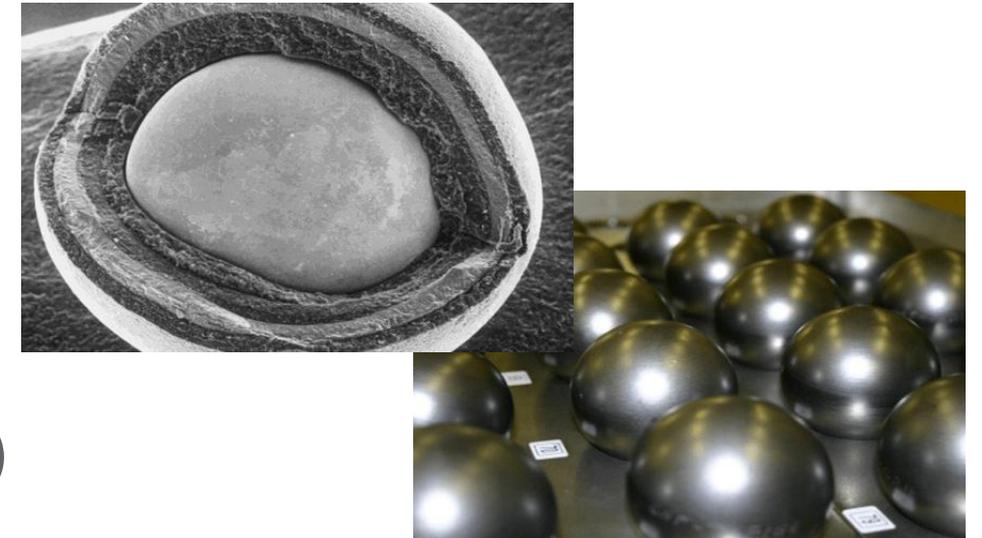
<https://www.energy.gov/ne/articles/infographic-advanced-reactor-development>



Benefits of Gen IV – Revolutionary Designs

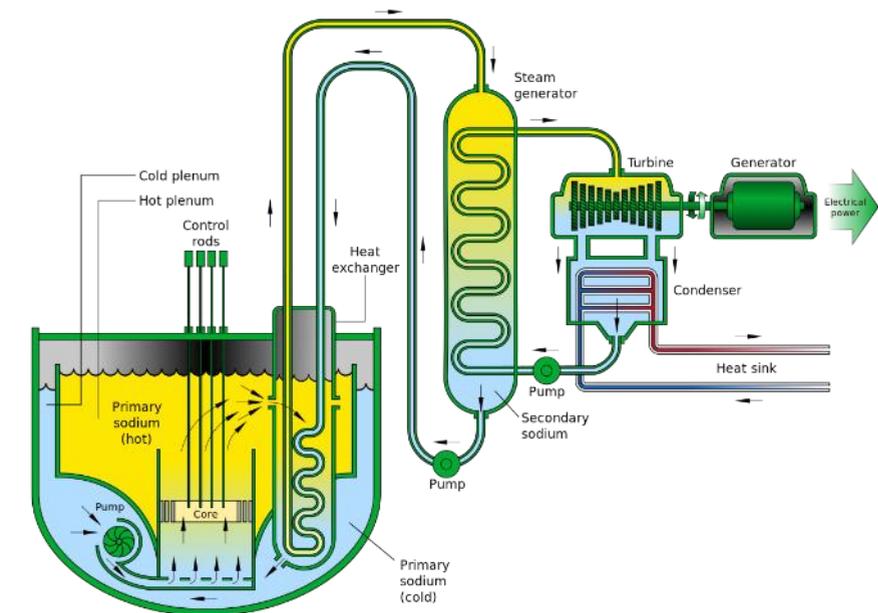
FUEL

- Higher enrichment and utilization (HALEU*)
- Self-contained, non-meltable fuel (TRISO)
- Shorter or online refueling (>95% capacity factor)



COOLANTS

- Improved efficiency (Higher temperatures)
- Simpler containment (Lower pressures)
- Less reactive and corrosive
- Fewer redundant and backup cooling systems



*HALEU – high-assay low enriched uranium

Status of **advanced nuclear** projects

- TerraPower and PacifiCorp pursuing a Sodium reactor in Kemmerer, Wyoming – retired coal plant (construction permit in review)
- X-energy and Dow Chemical pursuing a Xe-100 reactor in Seadrift, Texas – power and industrial site (construction permit in review)
- GE Vernova Hitachi and Tennessee Valley Authority pursuing a BWRX-300 at the Clinch River, Tennessee site (construction permit in review)
- Ontario power Generation and GE Vernova Hitachi received approval to construct the first of four BWRX-300 reactors at the Darlington site in Canada in May 2025
- Kairos received construction permits for the Hermes and Hermes 2 test reactors – Oak Ridge, Tennessee
- Fermi America tendered parts 1 and 2 of Combined License Application for Fermi America President Donald J. Trump Advanced Energy and Intelligence Campus, Units 1-4 (Westinghouse AP-1000)
- Holtec pursuing a SMR-300 at the Palisades, Michigan site (existing site)
- Meta power agreements with Vistra, TerraPower, and Oklo for 6.6 GW of capacity
- ENTRA1 collaborative agreement with Tennessee Valley Authority to deploy 6 GW of NuScale capacity
- Google agreement with Kairos for 500 MW
- Oklo agreement with Switch for 12 GW of capacity over 20 years

Status of **advanced nuclear** projects

Advanced Reactor (non-LWR and LWR) applicants, vendors, and research/test reactors that have notified the NRC of their intent to engage

High Temperature Gas Reactors	Light Water Reactors	Molten Salt Reactors / Molten Chloride Fast Reactors	Sodium Cooled Reactors	Other Designs/ Not Specified
Energy Northwest New Nuclear	Deep Fission	Abilene Christian University	* Aalo Atomics	* Antares Nuclear, Inc.
General Atomics	GE-Hitachi BWRX-300	Kairos Power, LLC	* ARC Clean Technology	Appalachian Power Company
General Atomics Electromagnetic Systems	Hadron Energy, Inc.	Natura Resources	Oklo Inc.	Blue Energy, Inc.
* Radiant Industries, INC.	* Last Energy	TerraPower, LLC	TerraPower & GE - Hitachi Natrium	* Deployable Energy
* Terra Innovatum (SOLO)	REPLOY Power, Inc.	Terrestrial Energy USA, INC.		Duke Energy - Belews Creek, NC
* University of Illinois at Urbana-Champaign - NANO Nuclear Energy Inc.	Rolls-Royce SMR Limited			Japan Atomic Energy Agency
X-Energy, LLC (XE-100)	SMR, LLC (Holtec)			* Shepherd Power, LLC
* X-Energy, LLC (XENITH)	Westinghouse AP300			Texas A&M University - RELLIS Campus
				* Westinghouse eVinci
Inactive Projects - There are no Inactive Projects at this time.				

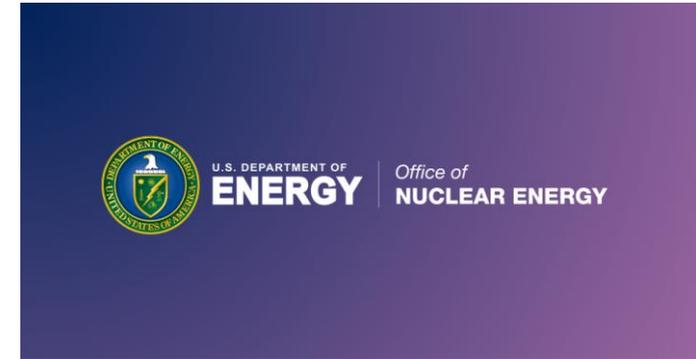
* Indicates Microreactor Design

<https://www.nrc.gov/reactors/new-reactors/advanced/who-were-working-with/pre-application-activities> (January 2, 2026)



Additional Resources

- U.S. DOE Office of Nuclear Energy
- U.S. Nuclear Regulatory Commission
- Electric Power Research Institute
- Nuclear Energy Institute
- Gateway for Accelerated Innovation in Nuclear





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Thank you

