

U.S. Department of Energy Advanced Reactor Research and Development Program for Fast Reactors

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Presidential and Departmental Nuclear Energy Priorities

- President Trump ordered review of nuclear energy policy:
“[W]e will begin to revive and expand our nuclear energy sector...which produces clean, renewable and emissions-free energy. A complete review of U.S. nuclear energy policy will help us find new ways to revitalize this crucial energy resource.”
- Nuclear energy role as clean baseload power is key to environmental challenges:
“If you really care about this environment that we live in...then you need to be a supporter of this amazingly clean, resilient, safe, reliable source of energy.”
Secretary Rick Perry at Press conference, May 10th
- Executive Order Promoting Energy Independence and Economic Growth
- Commercialization of advanced SMRs crucial to future of US nuclear sector



DOE-NE MISSION AND PRIORITIES

DOE-NE MISSION

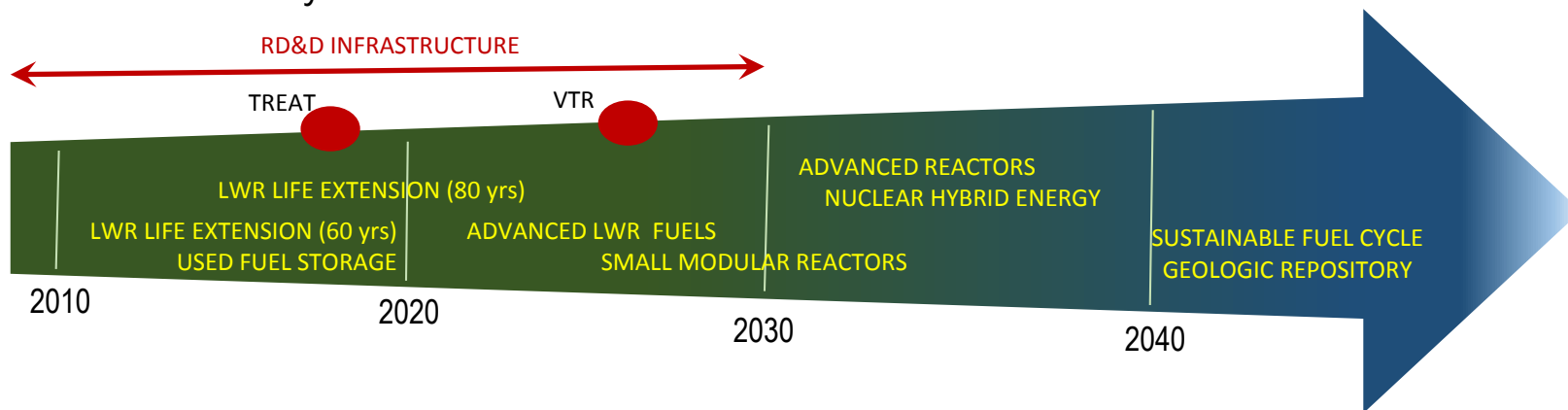
- Advance nuclear power as a resource capable of making major contributions in meeting our Nation's energy supply, environmental and energy security needs
- Seek to resolve technical, cost, safety security, and regulatory issues through RD&D
- By focusing on the development of advanced nuclear technologies, support the goals of providing domestic sources of secure energy, reducing greenhouse gases, and enhancing national security.

MISSION PRIORITIES

Existing Fleet

Advanced Reactor Pipeline

Fuel Cycle Infrastructure



DOE-NE ADVANCED REACTORS PIPELINE

REACTOR TYPES

Light-Water Based SMRs
e.g. NuScale

High-Temperature Reactors

- Prismatic & pebble bed designs
 - Helium Cooled
 - Molten Salt Cooled

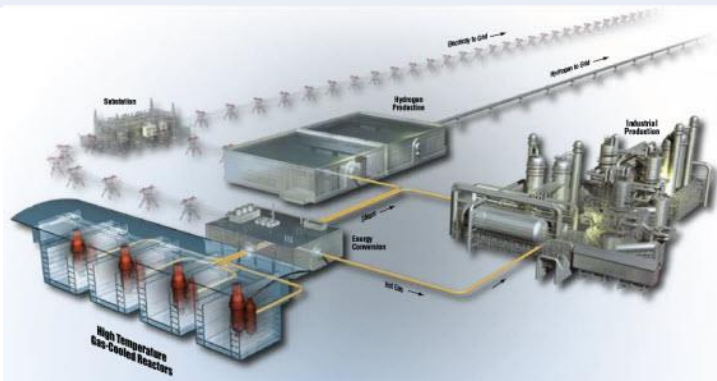
Emphasis: TRISO fuel and Graphite qualification

Liquid Fueled Reactor (Molten Salt)

- Fast-, thermal- and hybrid-spectrum designs

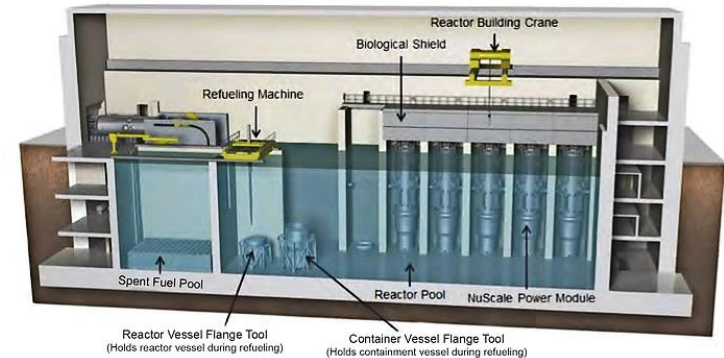
Metal-cooled Fast Spectrum Reactors

Micro Reactors



AREVA - HTGR

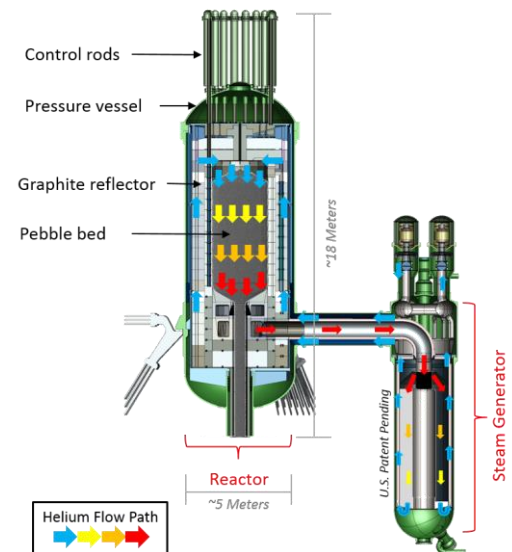
12 X 50 MWe Inside a NuScale Small Modular Reactor Building



Source: NuScale Power LLC

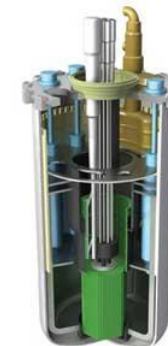
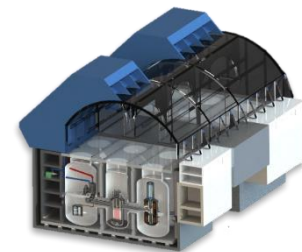
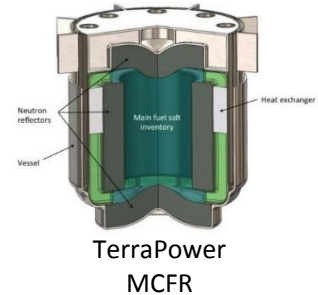
A BNA Graphic/react13g1

Xe-100 Pebble-Bed Reactor (200 MWth)



ADVANCED REACTOR TECHNOLOGIES FOCUS AREAS

- Advanced Light Water Reactors
- Fast Reactor Technologies
 - Demonstrate feasibility of advanced systems and component technologies
 - Methods and code validation to support design and licensing
 - Advanced alloy materials qualification for metal-cooled systems
- Gas Reactor Technologies
 - Advanced alloy and graphite materials qualification for high temperature gas-cooled systems
 - Scaled integral experiments to support design and licensing
 - TRISO-coated particle fuel development and qualification
- Molten Salt Reactor Technologies
 - Investigate fundamental salt properties
 - Materials, models, fuels and technologies for salt-cooled and salt-fueled reactors
- Cross-Cutting technologies
 - Advanced energy conversion
 - Supercritical Carbon Dioxide (sCO₂) Brayton Cycle
 - Micro reactors for remote defense and commercial applications



VERSATILE TEST REACTOR (VTR)

IN SUPPORT OF ADVANCED REACTOR TECHNOLOGIES

NEAC Advice:

- The need for a VTR was established through a series of independent surveys of the potential U.S. user community (industry, DOE programs) and support from international partners resulting in a NEAC report (“Assessment of Missions and Requirements for a new U.S. Test Reactor” 2/2017); it states that “The Ad Hoc NEAC subcommittee recommends that DOE-NE proceed immediately with pre-conceptual planning activities to support a new test reactor (including cost and schedule estimates).”

Goals:

- 3 year R&D effort, along with appropriate reviews and planning, leading to an operational VTR by 2026
- VTR would support accelerated development of advanced fuels and materials for U.S. advanced reactor vendors, as well as to provide the capability for testing those fuels and materials to support licensing by the Nuclear Regulatory Commission.
- VTR with a high fast neutron flux would revitalize our research infrastructure and remove a critical impediment for U.S. developers of advanced nuclear energy technologies.
- Constructed and operated under DOE authority, in close collaborations with NRC.
- \$35 million in 2017 Omnibus Bill for versatile fast test reactor’s R&D activities to achieve CD-0 in January 2019.

SUMMARY

- The demand for domestically-generated, reliable, and clean sources of base-load electricity will continue to drive many countries toward nuclear energy as part of their “energy security” and national economic and environmental calculus.
- Profound opportunity for new nuclear growth:
 - Strong global market interest
 - Growing need for increased global access to electricity
 - Support energy security, economic and environmental goals
 - U.S. leadership to ensure safety & nonproliferation are as important as ever
- The Administration is committed to advancing nuclear energy in the United States and abroad.

“Nuclear energy is a critical component of America’s energy future, and entrepreneurs are developing promising new technologies that could truly spur a renaissance in the United States and around the world.”



Back Up Slide

DRAFT REQUIREMENTS/ASSUMPTIONS

OF VERSATILE TEST REACTOR (VTR)

1. Approach to Design: Conducting a 3 year research & development effort on core design.
2. Reach fast flux of approximately $4.E15$ n/cm^2-s , with prototypical spectrum
3. Load factor: as large as possible (*maximize dpa/year to > 30 dpa/year*)
4. Provide flexibility for novel experimental techniques
5. Be capable of running loops representative of typical fast reactors (*Candidate Coolants: Na, Lead, LBE, Gas, Molten Salt*)
– May be a single location with replaceable loops.
6. Effective testing height ≤ 1 m
7. Ability to perform large number of experiments simultaneously
8. Metallic driver fuel (possible options: LEU, Pu, LEU+Pu)

VTR draft core map

