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Nuclear Data Needs for Current and Future Nuclear Energy Systems

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Outline

- Nuclear data needs for the current reactor fleet
- Westinghouse advanced reactor concepts
- Summary of the open questions/problems relevant to the Westinghouse advanced reactor program

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Current Fleet of LWRs

Nuclear Data for LWRs

- It does not seem that new measurements are needed for LWRs using UO_2 fuel
- New data needed for accident tolerant fuel (ATF) (e.g., U_3Si_2, UN, coated cladding, etc.)
- Westinghouse observed some discrepancies between the ENDF-VII.1 and ENDF-VIII.0. libraries:
  - A standard benchmark unit assembly (a typical 17x17 Westinghouse fuel assembly with IFBA) was modeled using ENDF-VII.1 and ENDF-VIII.0. Differences were observed between the two libraries.
  - 3 cycles of a 4-loop plant were calculated and results compared to plant measured data
    - Simulations performed with ENDF-VII.1 are in a good agreement with the plant data
    - Results of the simulations with ENDF-VIII.0 are significantly different and the difference increases with depletion. Power distributions and the critical boron concentrations were investigated.
- Information/feedback on the comparison of ENDF-VII.1 and ENDF-VIII.0 and experience of other users are of interest for us

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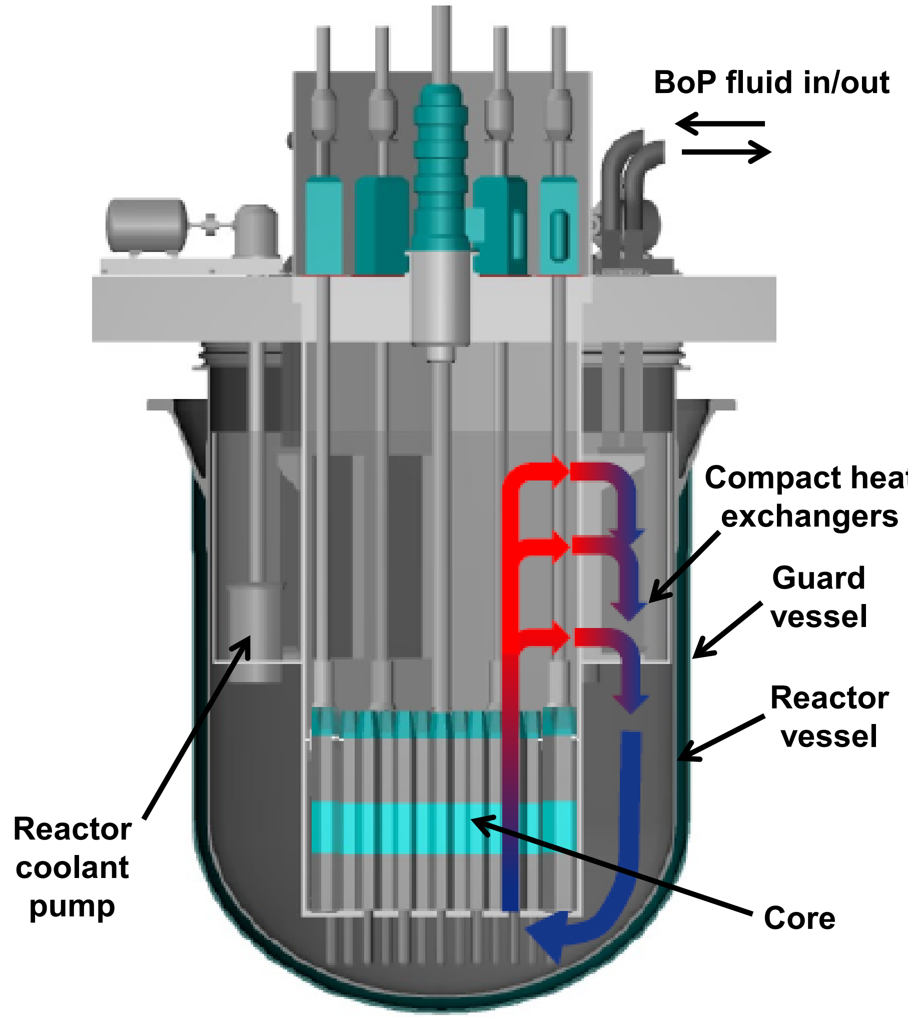
Lead-Cooled Fast Reactor (LFR)

A Glimpse at the Westinghouse LFR

- ~450 MWe, simple, robust, scalable and passively safe lead-cooled fast reactor
- Pool-type configuration with all primary system components in the same vessel
  - No intermediate circuit: primary heat exchangers immersed in the lead pool
- Adequate readiness of base technology, enhanced with selected innovations
- Key innovations:
  - Compact, hybrid micro-channel-type HXs
  - High-performance materials (incl. fuel)
  - Thermal energy storage



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Main Plant Characteristics

- Fast spectrum reactor
- Core inlet temperature: 420 °C
- Core outlet temperature: 530 °C (Prototype), 650 °C (main fleet)
- Primary pressure: atmospheric
- Fuels under consideration:
  - UN
  - UO2
  - MOX
- Other materials under consideration: different types of cladding materials (mostly steels, with and without coating, but also SiC), boron carbide, different materials for the reflector assemblies, etc.

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eVinci® Micro Reactor

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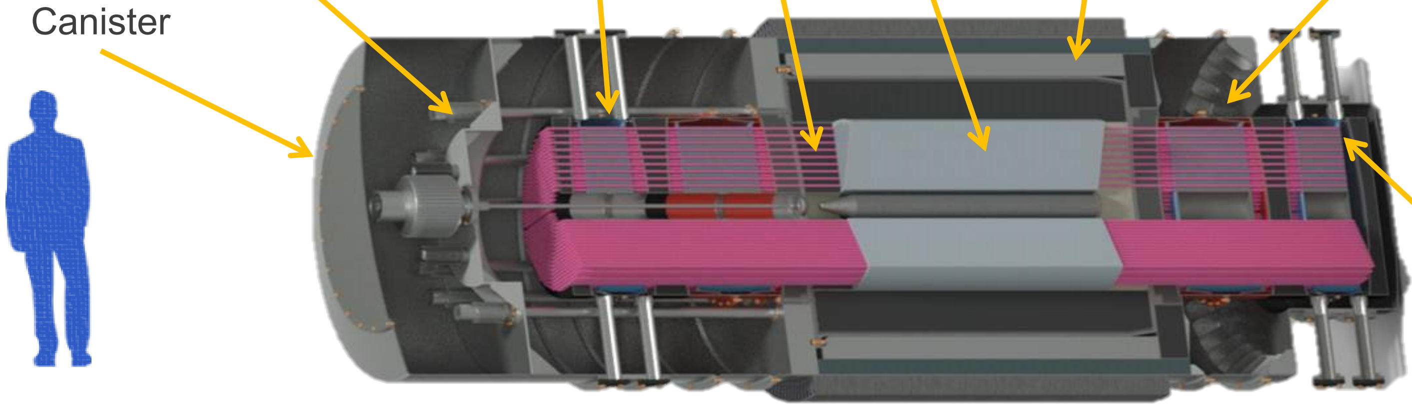
eVinci System Overview



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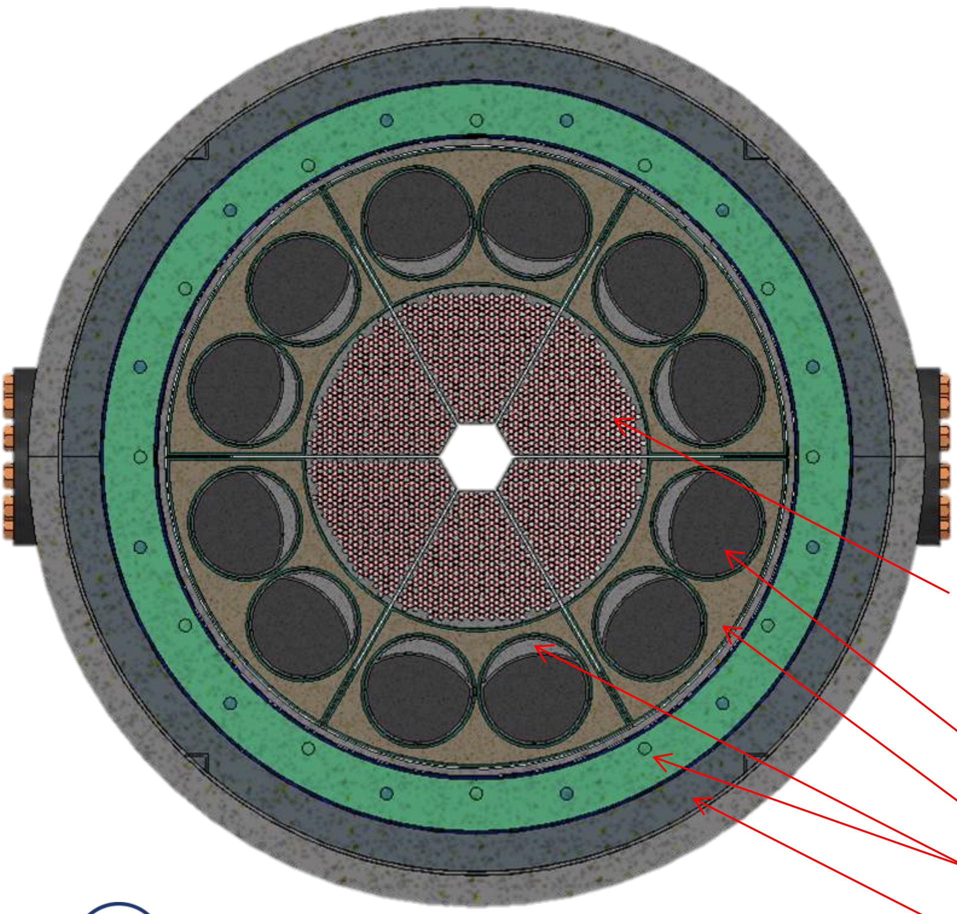
Solid Core Design



- Fast spectrum reactor
- Operating temperature: 650 °C
- Fuels under consideration:
  - UN
  - U_3Si_2
  - U-10Mo
- Other materials under consideration: aluminum oxide, beryllium oxide, different steels, TZM, boron carbide etc.

- Core block
- Control Drums
- Neutron Reflector
- Neutron Absorber
- Gamma Shield

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Westinghouse Advanced Reactor Needs

- Criticality benchmarks in the fast spectrum for the fuels of interest
- High quality nuclear data in the fast region for the reactions/isotopes of interest in the fuels (e.g., U235 and plutonium isotopes). Unresolved resonance energy range might be a challenge.
- High quality nuclear data for the non-fuel materials (for example, lead and iron isotopes)

THANK YOU