Westinghouse Lead Fast Reactor Program

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Genesis of Westinghouse Lead Fast Reactor Program

- Challenge: **Identify the technology with best potential to meet the key requirements for global commercialization:**
  - ***Safety***
  - ***Economics***
  - ***Marketability***
- Other evaluation criteria also considered – e.g., enhancement in natural resource utilization, technology readiness level, etc.
- **Clean sheet approach: no legacy from the past**
- All the most well-known technologies, and beyond, were screened
- LFR emerged as the best technology to meet our commercialization requirements, based on the evaluation criteria we considered

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Success Criterion for an Advanced Reactor Program

- **An advanced reactor program can only be considered successful if it leads to construction of more than 1or 2 reactors**
  - We must aim at commercialization. We must aim at a fleet
- Forty years ago, requirements for commercialization were qualitatively the same as today's, but their weights were different. Today:
  - More competitive markets
  - More emphasis on safety that, in the absence of design simplicity and inherent safety features, results in increased costs
- We have set some key requirements for an advanced reactor design

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Westinghouse Advanced Reactor Requirements

- **Competitive economics**
  - Competitive levelized cost of electricity (LCOE) but also reduced front-end investment to promote plant's "affordability" by a large number of customers
- **Safety**
  - Simple and robust design
  - Passive and inherent safety
- **Broader marketability**
  - Non-electricity applications to fulfill needs of diverse future markets (e.g., variable electricity generation, desalination, process heat, waste management)
- **Licensing assurance**
  - Simple and robust design
  - Limited number of first-of-a-kind features
- **Predictability in technical feasibility, development time and cost**
  - Sufficiently high technology readiness level
  - Streamlined technology development roadmap based on scalability

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Key Features of the Westinghouse LFR

Economic Potential

Compact Nuclear Island

High power density core

High plant efficiency

Design simplicity and modularity (shorter construction)

Unparalleled Safety

Integral configuration

Atmospheric pressure

No pressure-driven LOCA

High boiling point coolant

Chemically-inert coolant

Strong reactivity feedback

Enhanced defense in depth barriers (FP retention capability by Pb)

Global Marketability

All plant sizes: battery-type, SMR, GWe-size

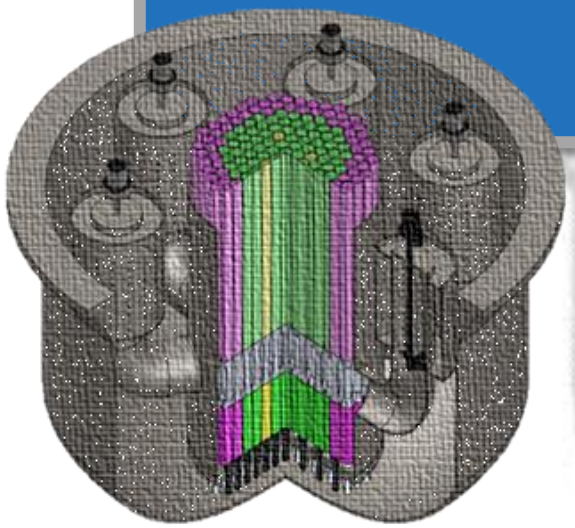
Energy storage capability for variable electricity output

Non-electric applications

Reduced Emergency Planning Zone (EPZ) size

Potential for long-life core

Potential to close fuel cycle (improve waste management and public acceptance)



Promising combination of safety, performance and marketability, combined with adequate technology readiness

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Common Misbeliefs and Facts on LFR Technology

MISBELIEFS

LFR technology OFTEN PICTURED AS:

- Low Technical Readiness Level
- Having insurmountable corrosion challenges
- Very long-term deployment

FACTS

LFR technology IS:

- **Seriously pursued in EU & Russia**
- **< ~480°C corrosion is addressed using tested and demonstrated materials. Promising results are being obtained with new materials up to 700°C (more testing to confirm)**
- **LFR technology readiness is compatible with demonstration by 2030, with higher performance evolutions to be deployed later as materials and advanced fuel are proven and qualified**

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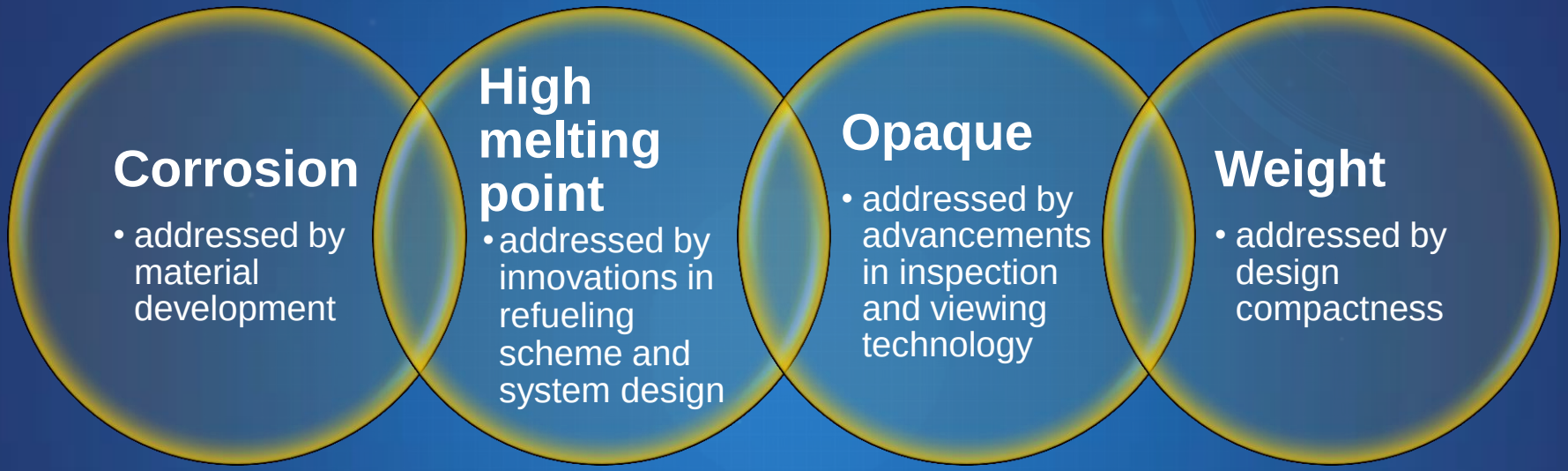
LFR Key Challenges



Challenges are not inherent showstoppers and can be addressed through development programs

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Westinghouse LFR Program

- Program key elements:
  - Westinghouse broad experience in nuclear
  - Collaboration with organizations having know-how and expertise in lead technology and fast reactor design, domestically and internationally
- Informing / stimulating / involving the global community on LFR technology
- Currently working on the LFR design best suited for the demonstration-to-commercialization path. Key activities include:
  - Plant layout development
  - Assessment of demo-to-commercial transition
  - Cost assessment

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Demonstration and Commercial LFR

- Demonstration LFR: focus on proven materials
  - T_{hot}≤ 500°C to manage corrosion (yet with ~40-42% efficiency)
  - Proven materials (D9, SS316) and fuel (UO_2), from SFR experience
- Commercial follow-on units: higher efficiency for best economics and broader range of applications beyond baseload electricity
  - Temperature increase up to 700°C (efficiency in the upper 40s)
  - Advanced fuels (we will leverage our Accident Tolerant Fuel [ATF] program)

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Global Engagement in the Advanced Non-LWR Arena

- Participated in the Advanced Test & Demonstration Reactor study
- Collaborating with National Laboratories and Universities to advance key technologies
- Actively engaged with key industry groups
- Continued support of U.S. Department of Energy (DOE) initiatives
- Supporting enhancement of experimental facilities for lead technology research and development in the U.S.
- Presented vision/program on LFR technology development to LFR Steering Committee of the GenIV International Forum
- Ongoing discussions with European organizations that are leading Pb-based technology development

Conclusions

- Westinghouse selected LFR as its advanced reactor technology because of the ***economic*** *and* ***market potential*****,** *the* ***outstanding safety case*****,** *and the* ***confidence in engineering and licensing viability***
- We are informing / stimulating / involving the community on LFR technology
- We look forward to collaboration opportunities for accelerating LFR development
- We have a demonstration-to-commercial LFR roadmap that we are continuing to evolve

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Thank-you