Emerging Lead-cooled Fast Reactor (LFR)

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INTERNATIONAL WORKSHOP ON ADVANCED REACTOR SYSTEMS AND FUTURE ENERGY MARKET NEEDS

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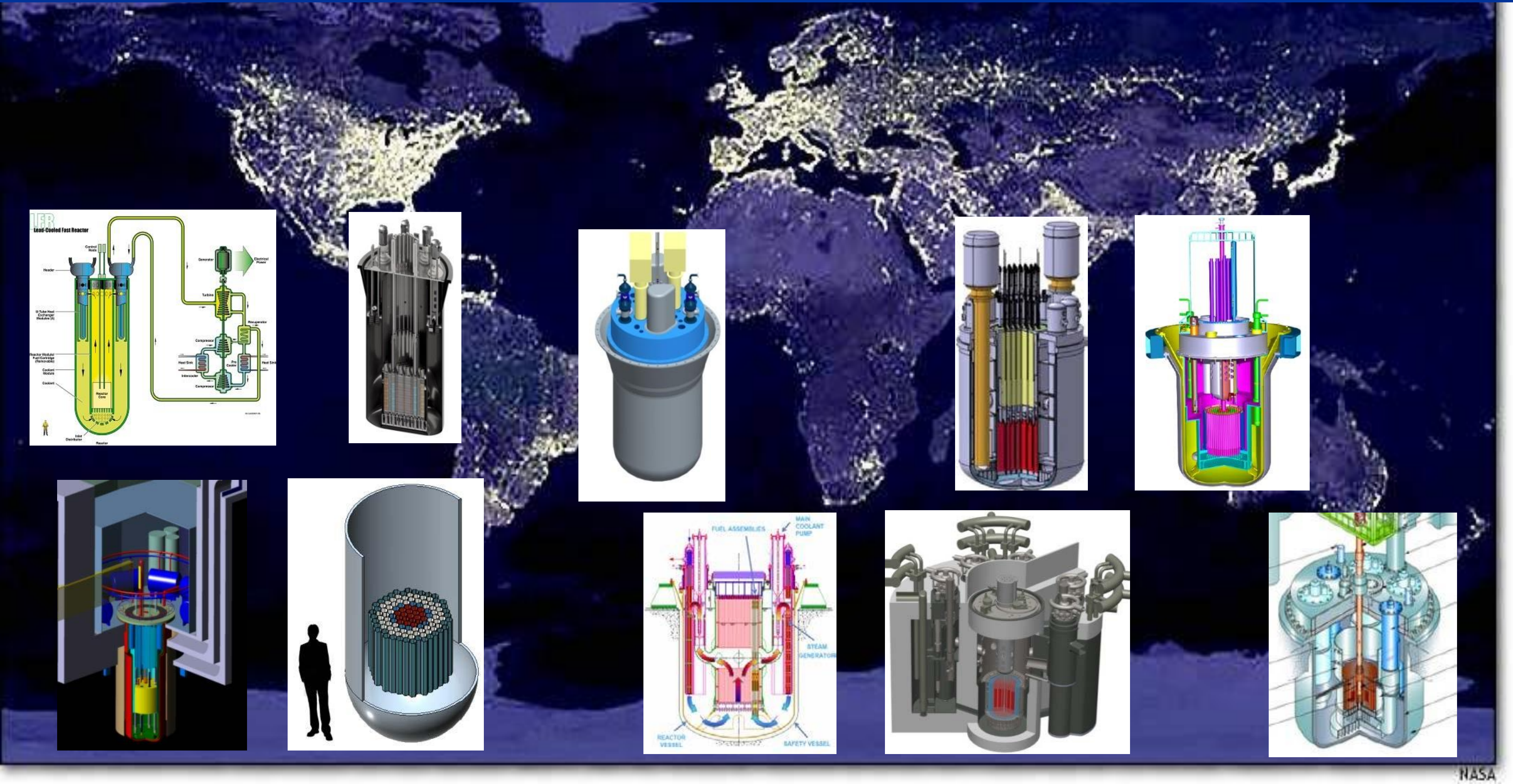


Enhanced Safety of Lead-cooled Fast Reactors

derived from 80 reactor-year operating experiences of 15 reactors including seven (7) "Alfa Class Submarines"

Accident by
-Internal
-External
Events

B.P. = 1743 C
Nat. Circulation
$\rho(Pb) \sim \rho(UO_2)$

Dry-out
Melt-down

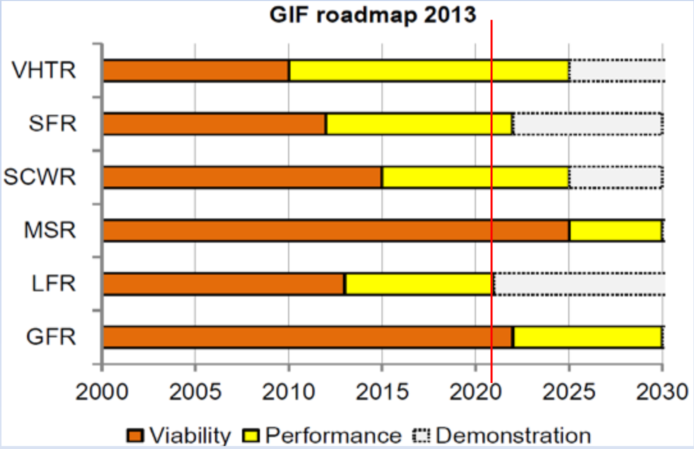
Recriticality

Inert (no H2)
Neg. Pressure
FP Retention

Hydrogen
Explosion

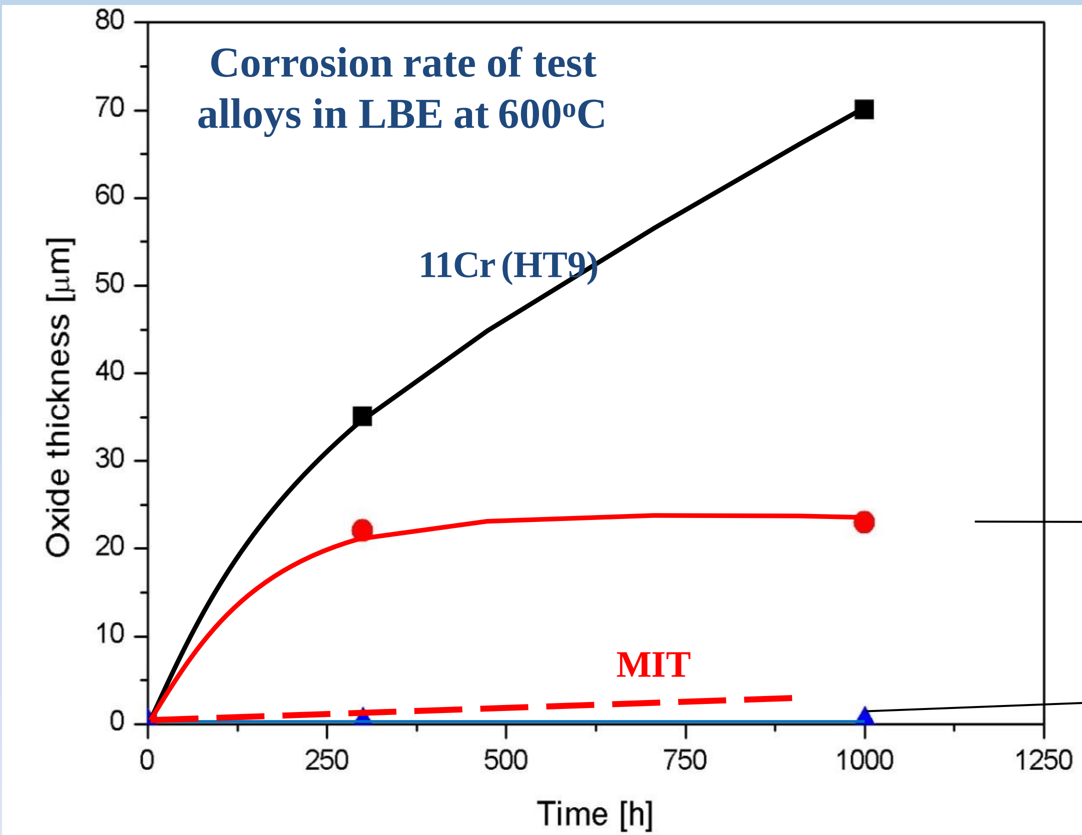
Off-site Rad.
Release

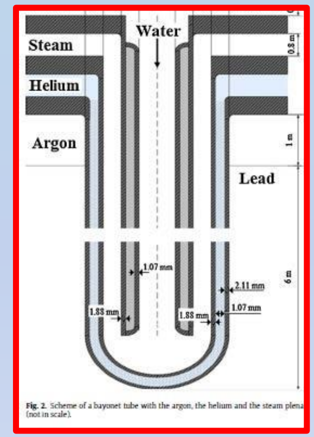
GIF Roadmap 2013



Innovative and Ready Materials (FeCrSi, FeCrAl)

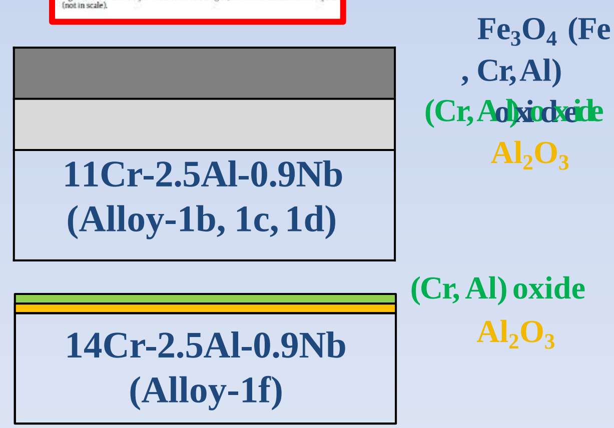
- Corrosion-resistant cladding on Code-Certified Materials
- S.G. Tubing➔ Double-wall ➔ Leak-Before-Break (LBB)
- Coolant Chemistry Management (impurity, particles)
- Employing pure Lead (Pb) to suppress Polonium-210





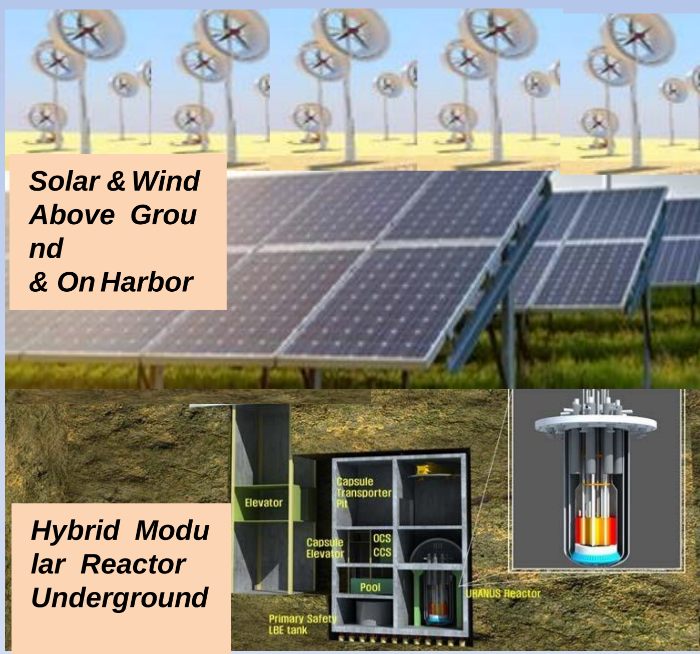
ALFRED

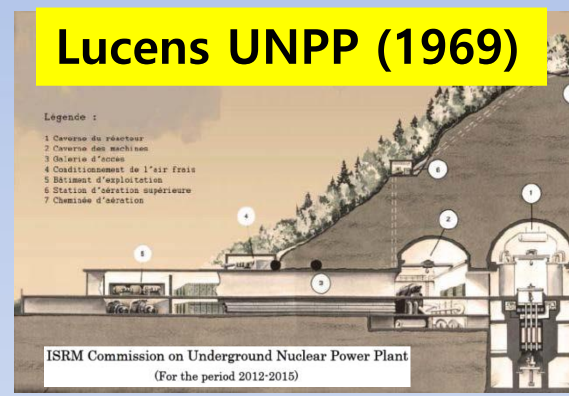
Nuclear Engineering and Design · December 2013

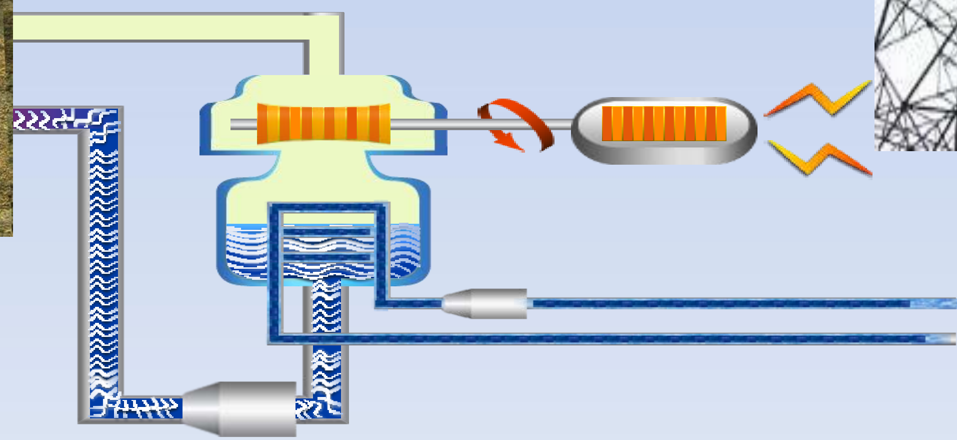


Zero-radius Emergency Planning Zone (EPZ)

- Underground LFR → Security and Seismic Resistance
- No Steam Generator Tube Rupture by Leak-Before-Break
- Main Steam Line Break → Negative Reactor Pressure
- No Radiation Release → All Coal Plant Sites are Suitable for LFR

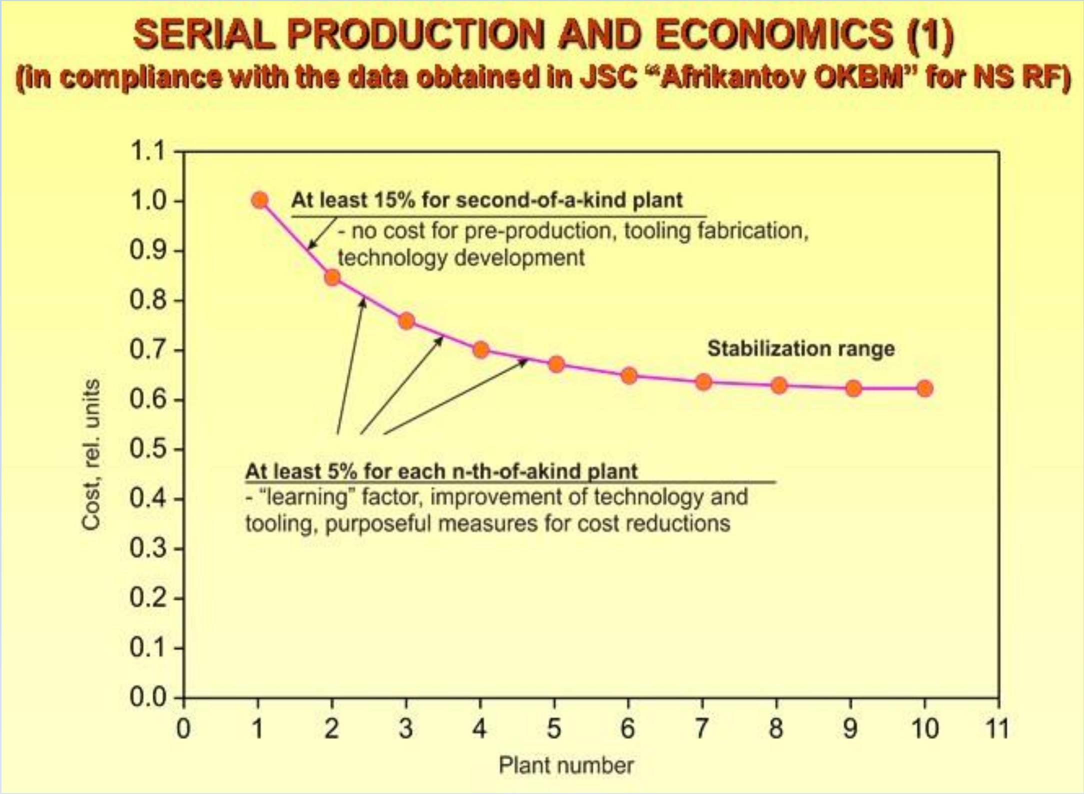


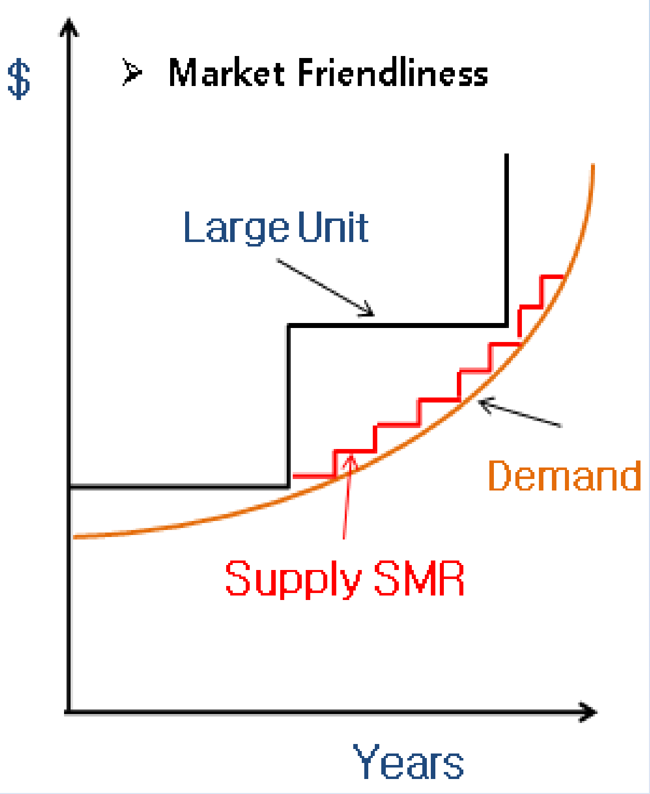




Market Attractiveness of Underground LFR

- High Steam Temperature → Coal Plant BOP can be Reused.
- Large Thermo-Mechanical Margin→ Load Follow for Renewables
- 30 year life for reactor and fuel→ No Refueling Cost
- Economies of Multiples & Low Financial Risk





Security, Safeguards, Sustainability & Wastes

- Underground Rugged Facility ➔ Security
- No On-site Refueling or Spent Nuclear Fuel Storage ➔ Safeguards
- Initial <20% U-235 ➔ Future Recycled TRU Fuel ➔ Sustainability
- Recycling: Future Multinational Cooperatives ➔No HLW produced!

"CRADLE-TO-GRAVE"

- IFNEC (OECD/NEA-USA)
- INPRO (IAEA-RF)