Closing Nuclear Fuel Cycle by Multi-National Approach

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Nuclear Fuel Cycle
Advanced Partitioning & Transmutation
Multi-National Approach (MNA)
Summary

Outline

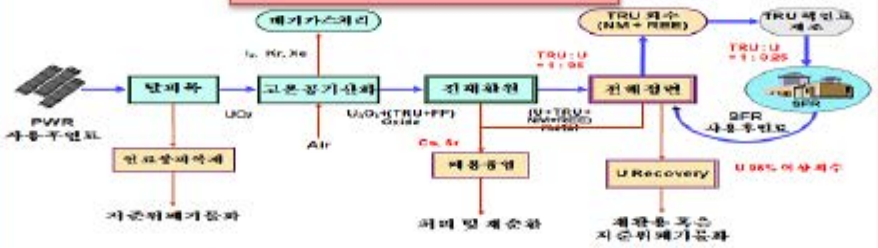
- Nuclear Fuel Cycle
- Front End Fuel Cycle: Uranium Enrichment
- Back End Fuel Cycle: Advanced Recycling
- Advanced Partitioning & Transmutation
- Multi-National Approach (MNA)
- Summary and Conclusion

Repositories for LILW are accepted, but not for HLW

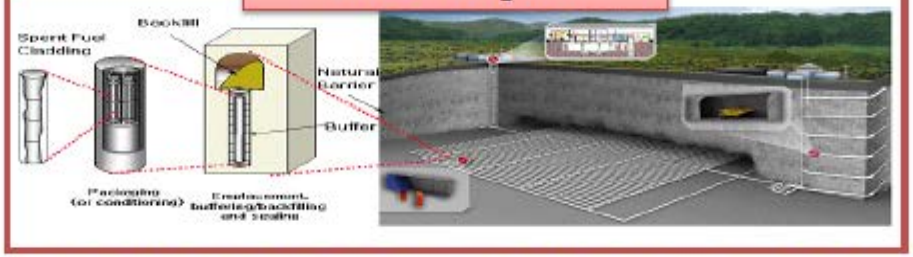
Current State : HLW Disposal

Optimum Plan : Decontaminating HLW into LILW

Volume Reduction

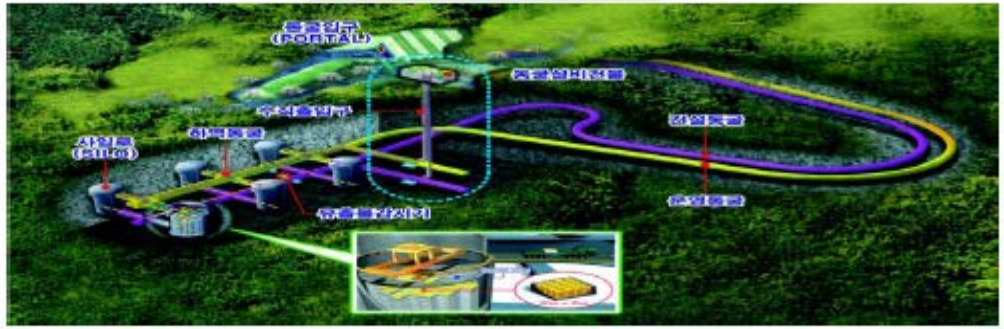


Direct Disposal

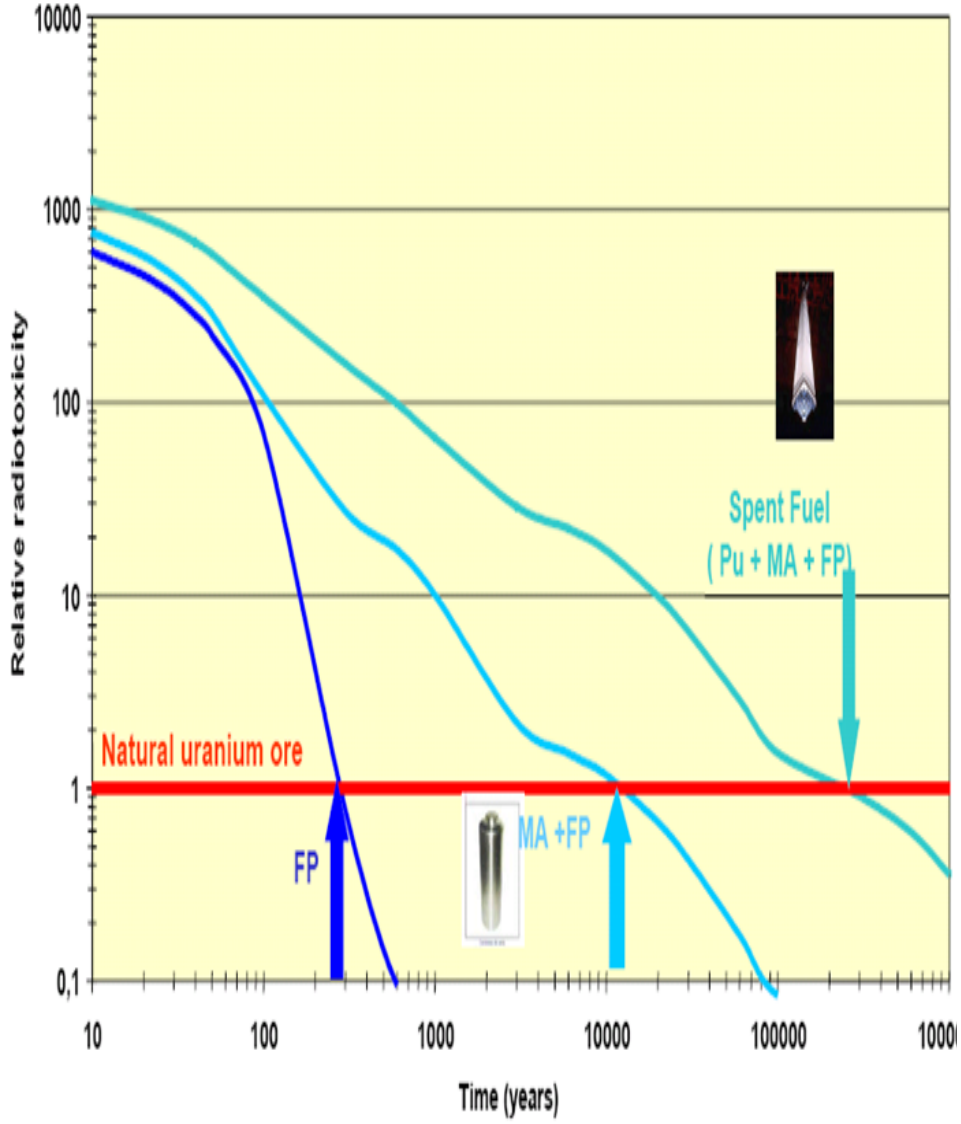


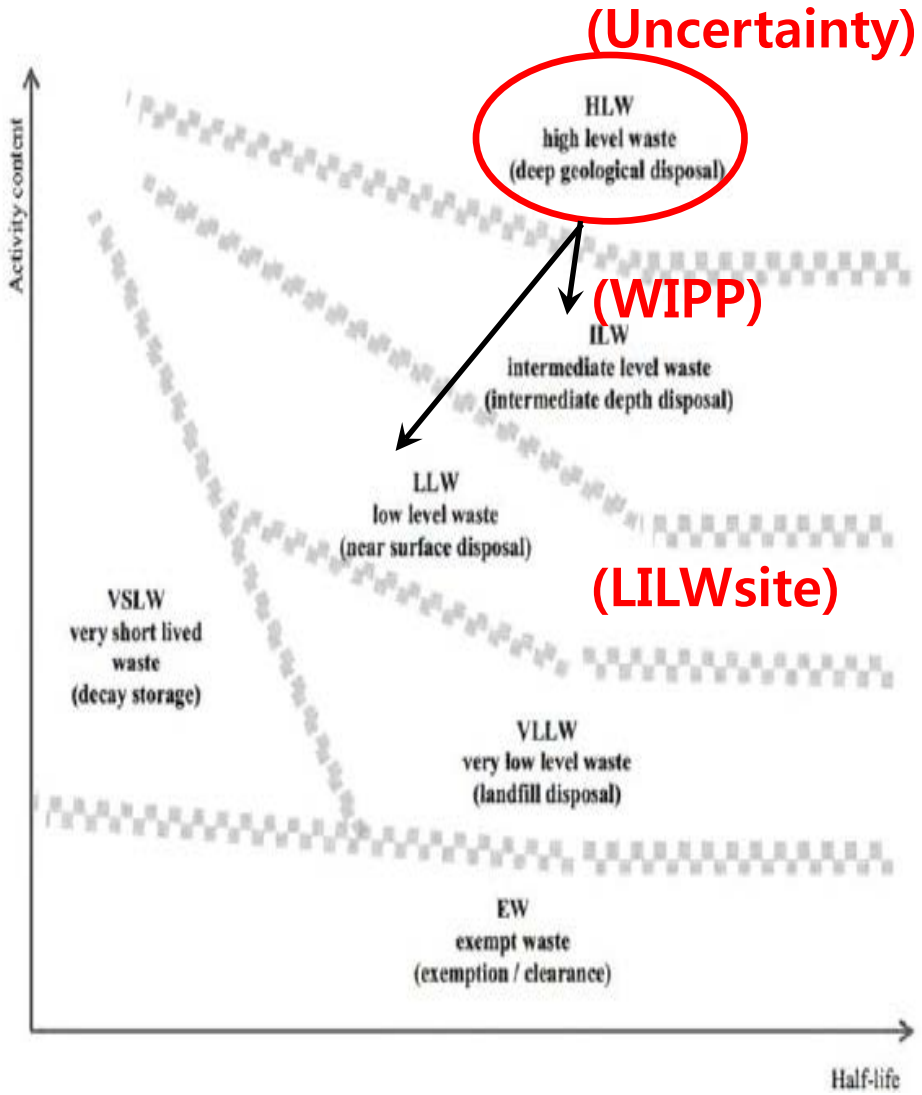
Interim Storage

LILW Disposal



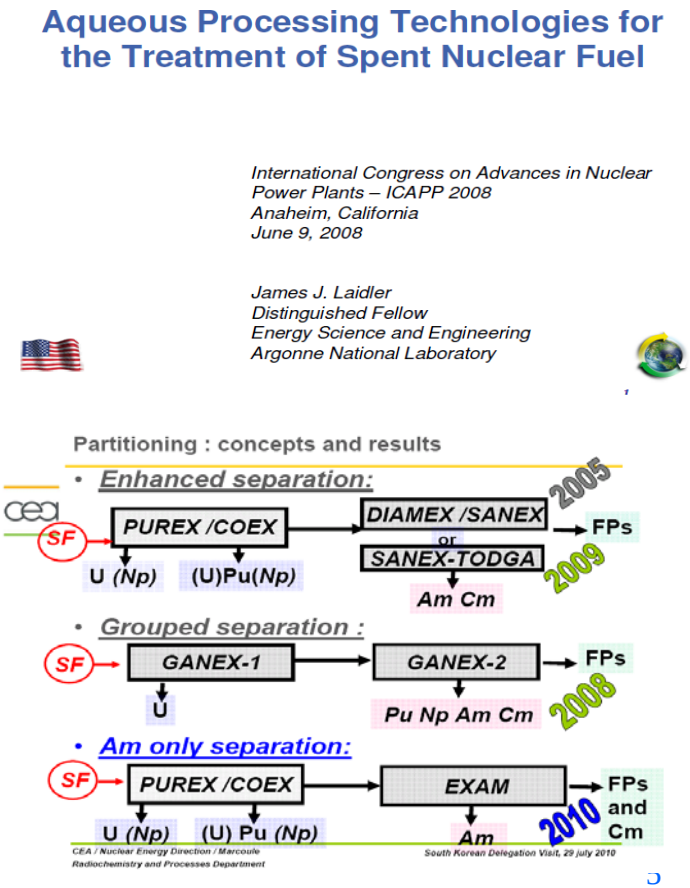
Advanced Back End Fuel Cycles





Game-changing Innovation to Eliminate HLW

- US Academy of Science (J. Shapira, 1999) : "Negative"
- ANL (J. Laidler, 2008)
  - Developed UREX+ for SNF Decontamination
  - High DF has been achieved ~ 30,000
  - Meet Class C LLW Cleanliness
  - Uranium recycle,
    - TRU << 100 nCi/gm
  - Cs, Sr, ,
    - TRU < 100 nCi/gm
    - Class C LLW after 150 year cooling
- SNU (I.S. Hwang, 2006~)
  - "PyroGreen " R&D with KAERI, INL
- SCK-CEN (H.A. Abderrahim, 2010)
  - MYRRHA for "burning HLW"
  - CEA Advanced Hydroprocess
- US DOE WIPP
  - Safety of ILW Disposal

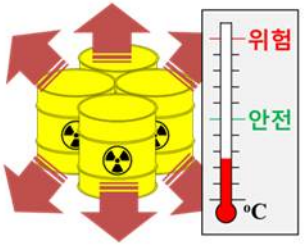


Game-changing Innovation to Eliminate HLW

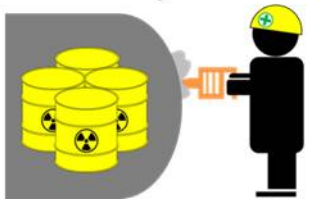
➢ WIPP site vs. YMP

- ~20,000 times lower α concentration
- ~1,000 times lower heat
- 650m underground rock salt
- Repository only 2.5°C up
- Prevention rock fracture
- Slow waste dissolution
- Prevention back-fill materials degradation
- Long-term uncertainty removal
- Human intrusion risk
- Successful operation in NM, USA since 1999

- Low heat density
  - ➢ Rock stability



- Low α concentration
  - ➢ Human intrusion security



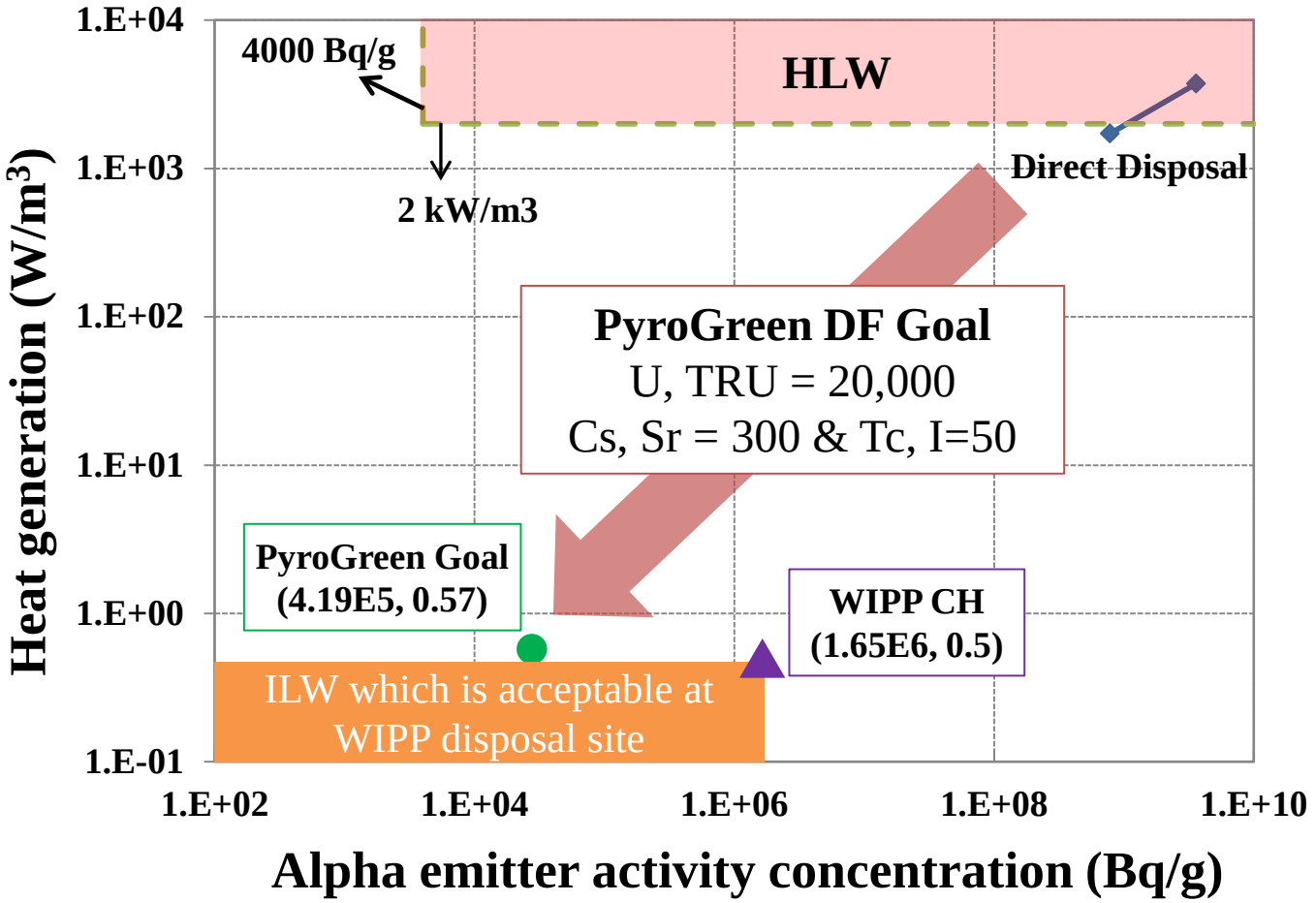
US Waste Isolation Pilot Plant
GTCC-Like (TRU) Low Level Waste

➢ Japan demonstrated advanced decontamination process
- CRIEPI(Pyro) and JAEA(aqueous) achieved WIPP Goal

➢ U.S. BRC recommends a game- changing Innovation
- All reprocessing wastes are classified into HLW by U.S. law
- U.S. NRC began public hearing for risk-based waste classification
- ANL achieved WIPP goal by UREX+ at lab scale

Advanced Back End Fuel Cycles

- **PyroGreen DF Goal set-up (Criteria : α-radioactive & heat density)**
  - **Analysis on 8 scenarios by the function of DF**
  - Set-up of DF Goal which satisfies **WIPP disposal site α-radioactivity and heat density**



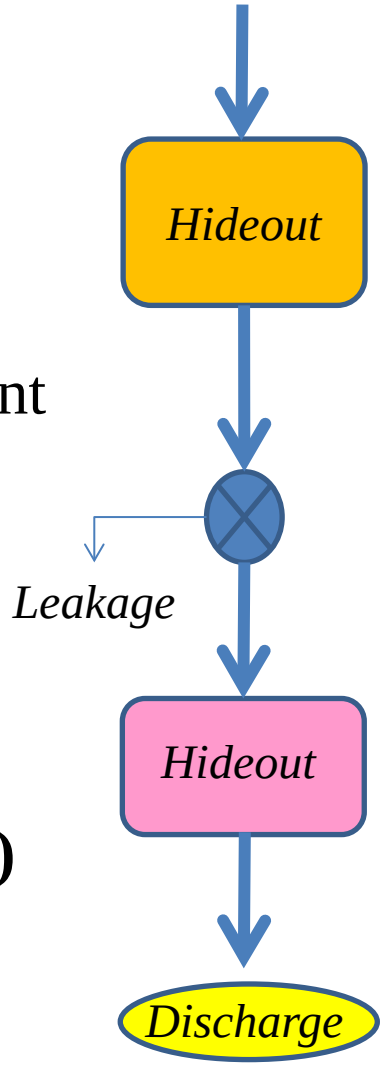
Materials Loss in Back End Fuel Cycle

➢ Materials Losses in Separation Process

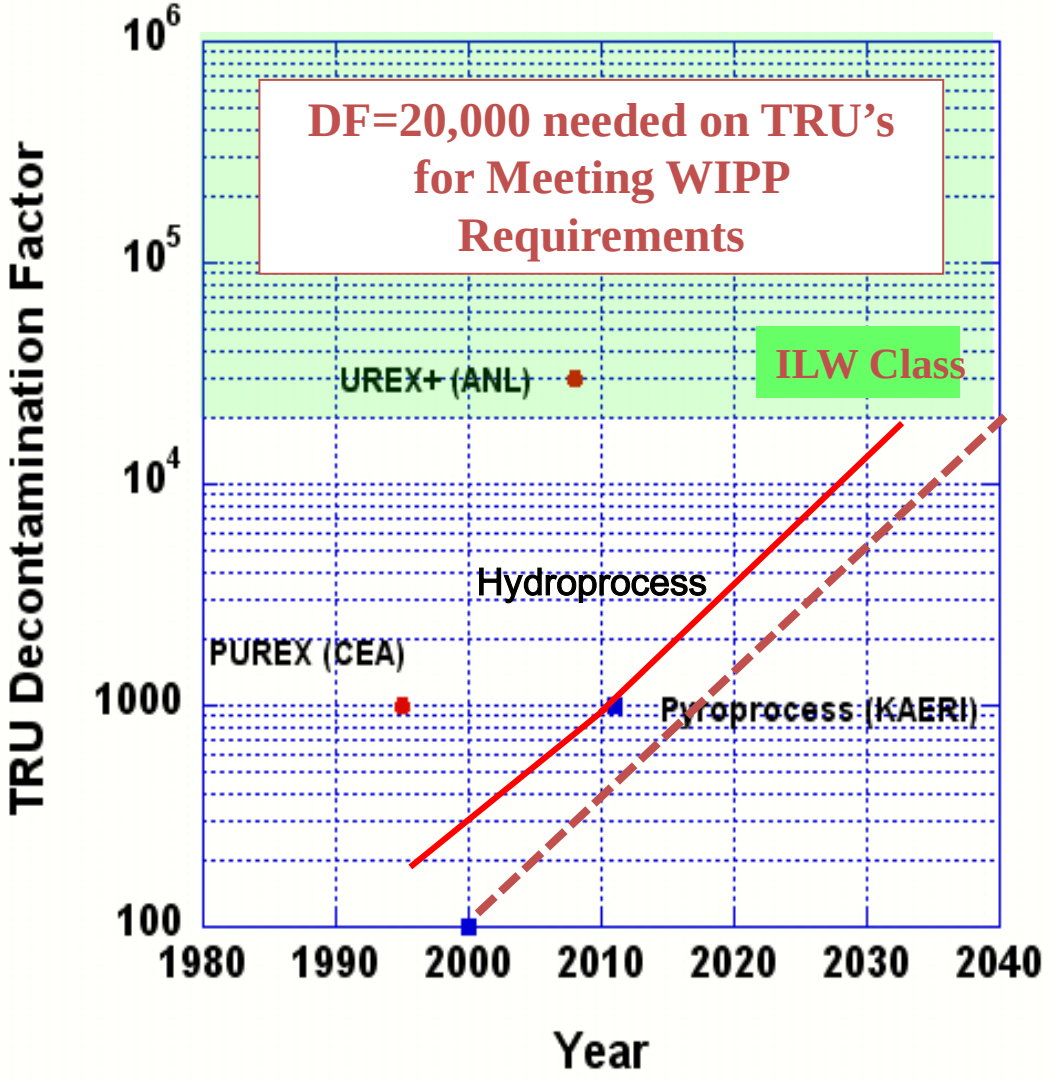
- Materials Loss within a Process Unit **(Hideout)**
  - Recovered by periodic decontamination
  - Controlled by unit design/materials improvement

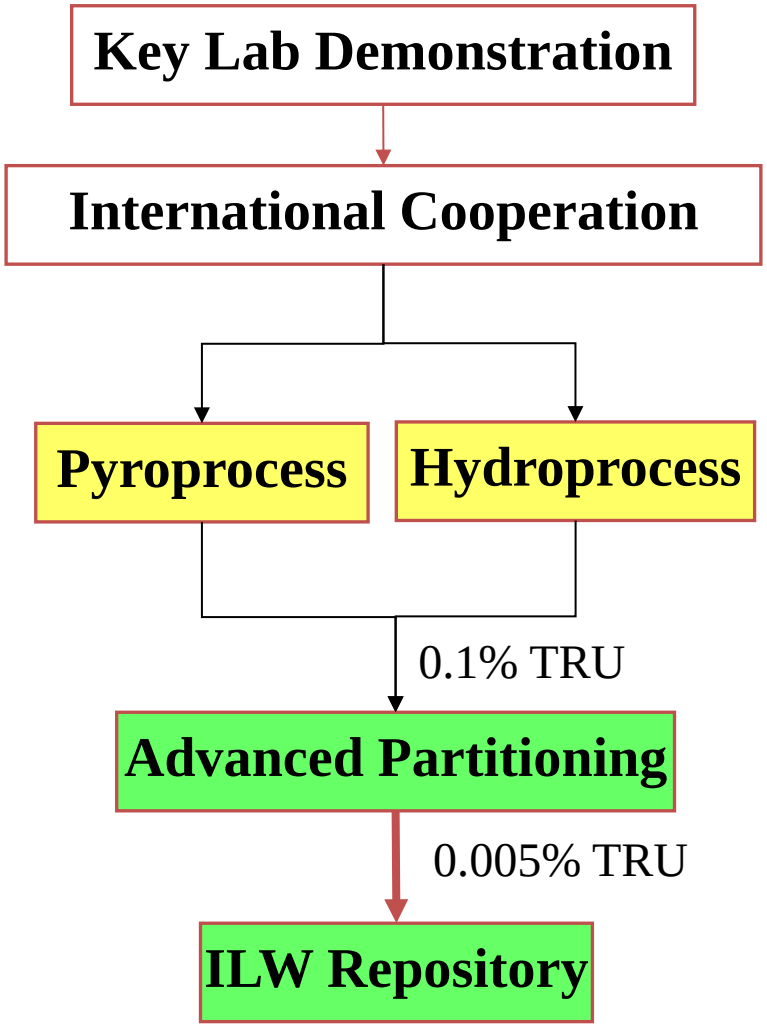
- Materials Loss out of a Process System **(Leakage)**
  - Controlled by assuring Leak-tightness (ex. Fuel fabrication process loss)

- **Waste from a Process System (Waste Discharge)**
  - **Process performance limit : measured**



Advanced Recycling: Industrial Process-2050





Multi-national Approach : Safety and Fuel Cycle

Nuclear Nonproliferation and Security
Enrichment and Reprocessing
Multinational Approach