Session 4b: Designs under development
(non-water-cooled Gen IV and SMRs)

# Sodium Cooled Fast Reactor

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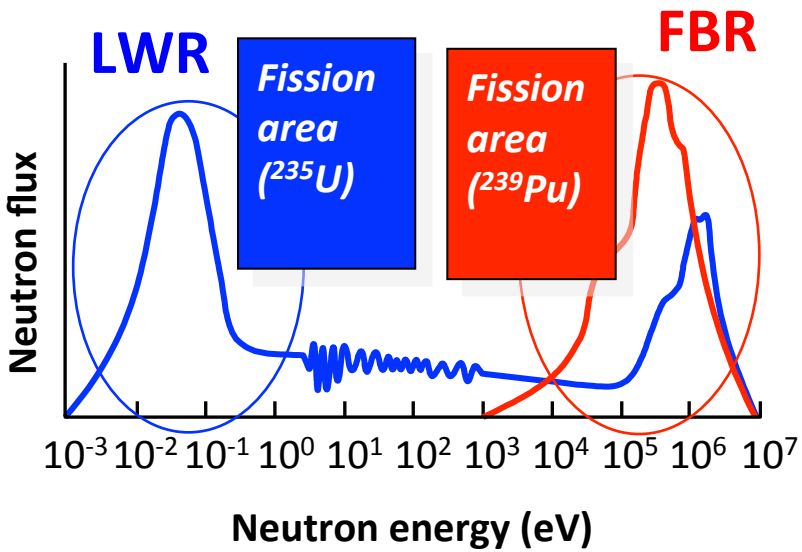
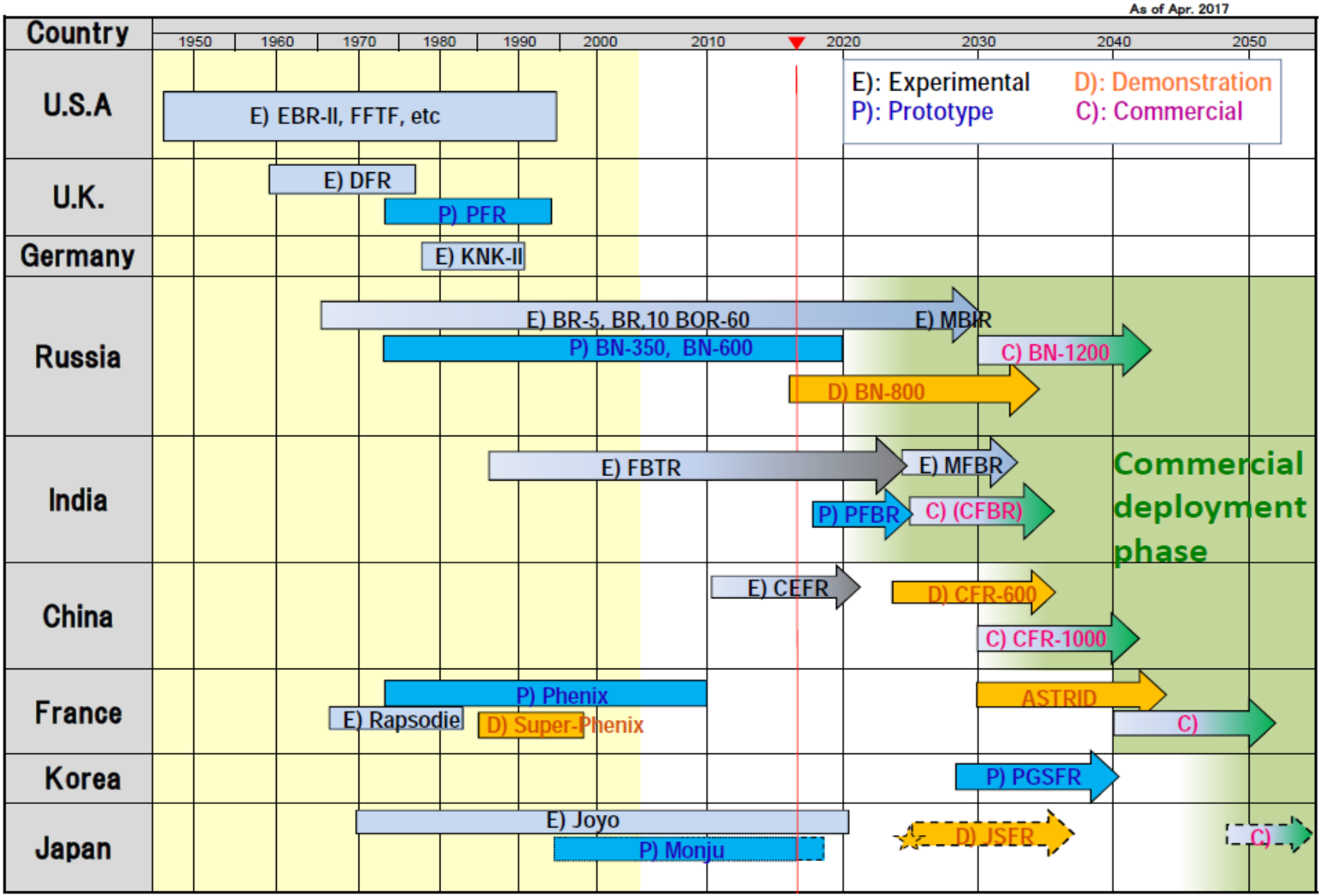
# Features of SFR System

- **Fast Neutron**:
  - ✓ Neutron energy is high
  - ✓ Neutron yield per absorption (fission) is greater than 2.0
  - ✓ U-238+n → Pu-239
  - ✓ Effective Use of U/Pu
- **Sodium Coolant**:
  - ✓ Less neutron moderation
  - ✓ High Temp. (around 550℃)
    - high thermal efficiency
    - Structural Design guideline
  - ✓ No Pressurization
  - ✓ Compatible with Structural Materials
  - ✓ Sodium-Water Reaction

Fig.1

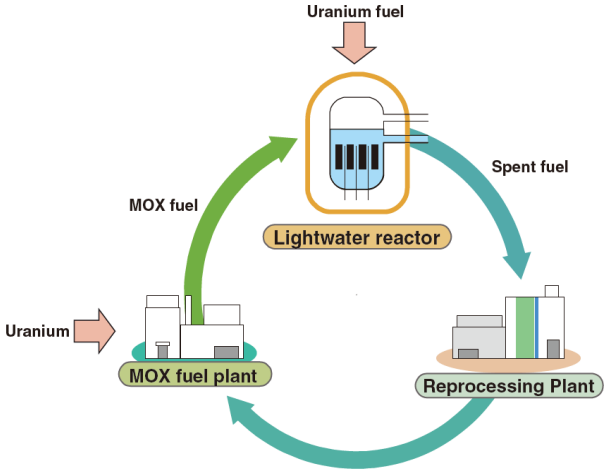


# SFR Development in the world



# Fuel Cycle (Pu/Minor Actinide recycling)

- Effective Use of U (Pu utilization)
- Reduction of Environmental Burden
  - Reprocessing recovering U and Pu from spent fuel reduces the volume of HLW (Fig.1)
  - Minor Actinide recycling reduces the radiotoxicity of HLW (Fig.2)



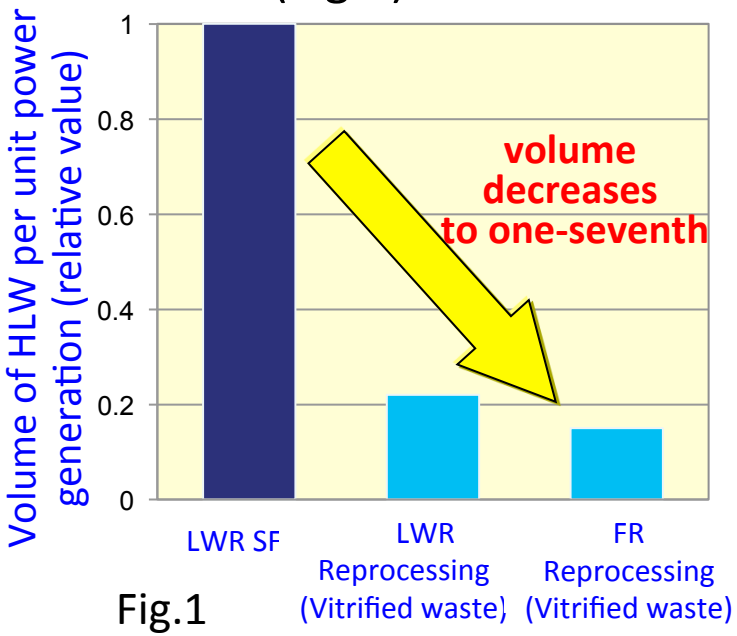




Fig.1

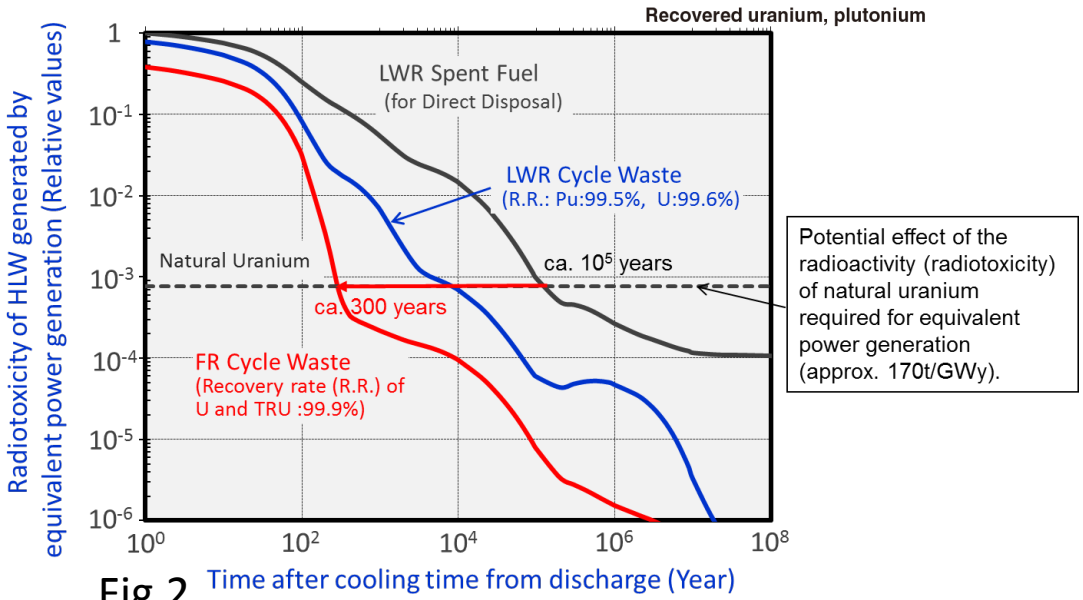
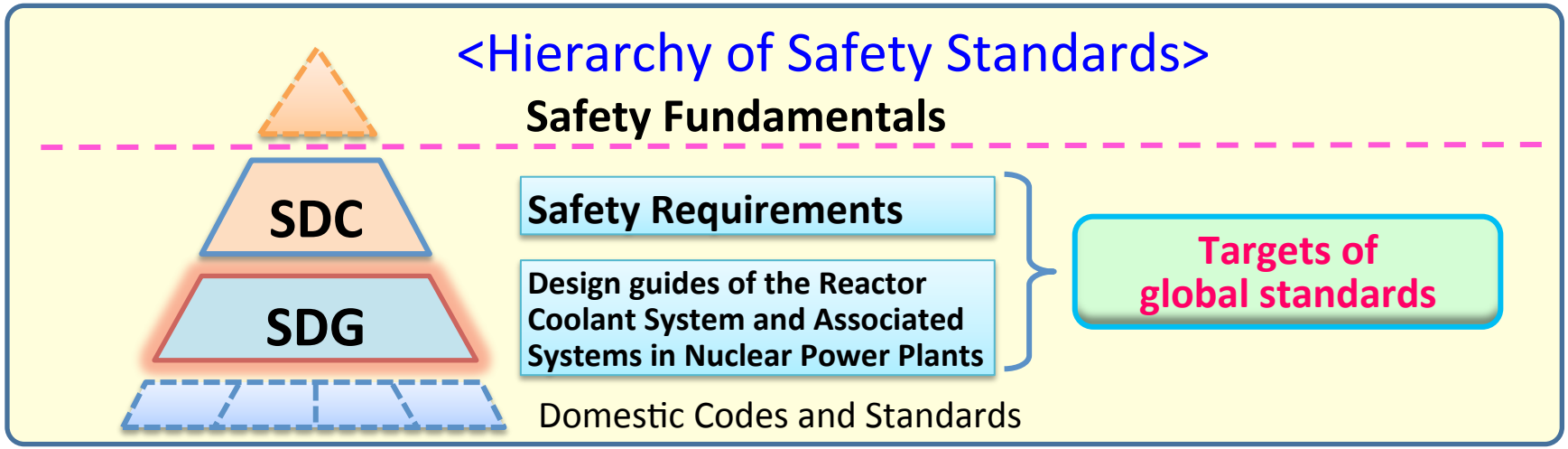



Fig.2

# Safety Design Requirement considering FR features



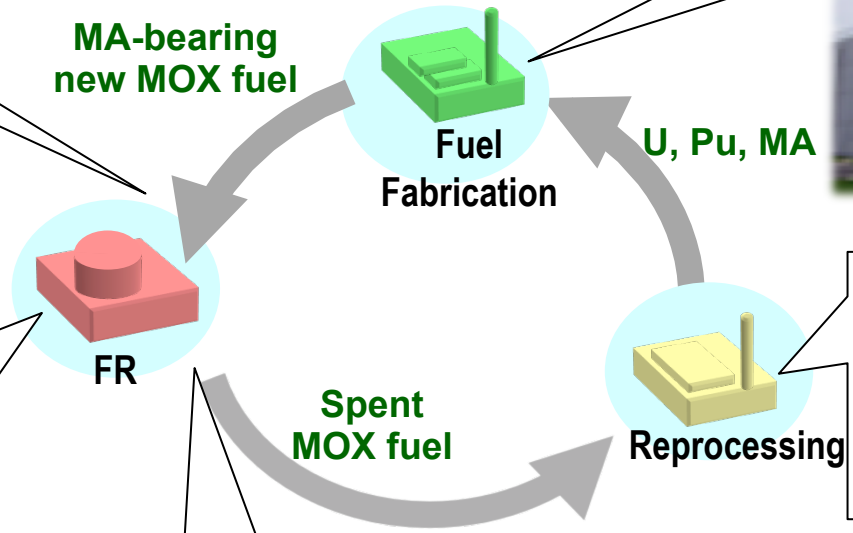

Aiming for "Eliminate of the need of off-site emergency"

| | | |
|---|---|---|
| Prevention of Core Damage | | Design Basis Accidents |
| | Design Extension Conditions | Prevention Situations |
| Mitigation of Core Damage | | Mitigation Situations |
| Residual Risk | | Situations covered by Practical Elimination Demonstration |

# JAEA's FR cycle R&D facilities

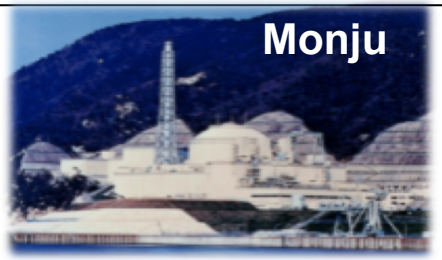
**Fuel Development & Irradiation Test:**
- Systematic irradiation tests of MA-bearing MOX fuel, High Pu-contents MOX fuel

**Fuel Fabrication:**
- Remote MA-bearing MOX fuel fabrication technology
- Determination of fuel composition range applicable




**Reprocessing:**
- Development of MA partitioning process and performance evaluation
- Establishment of feasible process concepts

**Reactor Characteristics & Reactor system:**
- Feasibility confirmation of FR plant technologies
- Acquisition of characteristics of MA-containing core




**Sodium Test :**
- Demonstration of Large Sodium Component

(MA：Minor Actinide)

# Market Issue

- ✓ ***Define Gen IV System R&D activities: Attractive designs for deployment in a energy market environment (2040-50)***
  - ***Sustainability (Waste burden, effective fuel use, Global Warming)***
  - ***Economics (Costs of Construction/Operation & Maintenance/Fuel Cycle, Financial Risk)***
  - ***Public Acceptance (Safety and Environment)***
- ✓ ***Increase the opportunity; Load-Following, Harmonizing with fluctuating power of renewable energy and a smart-grid, Small Modular Reactor, Non-electric application,***
- ✓ ***Crosscutting Issues: Materials, Safety Standard & Guideline, Education & Training***