Benefit and Challenges of collaborative study in JAEA

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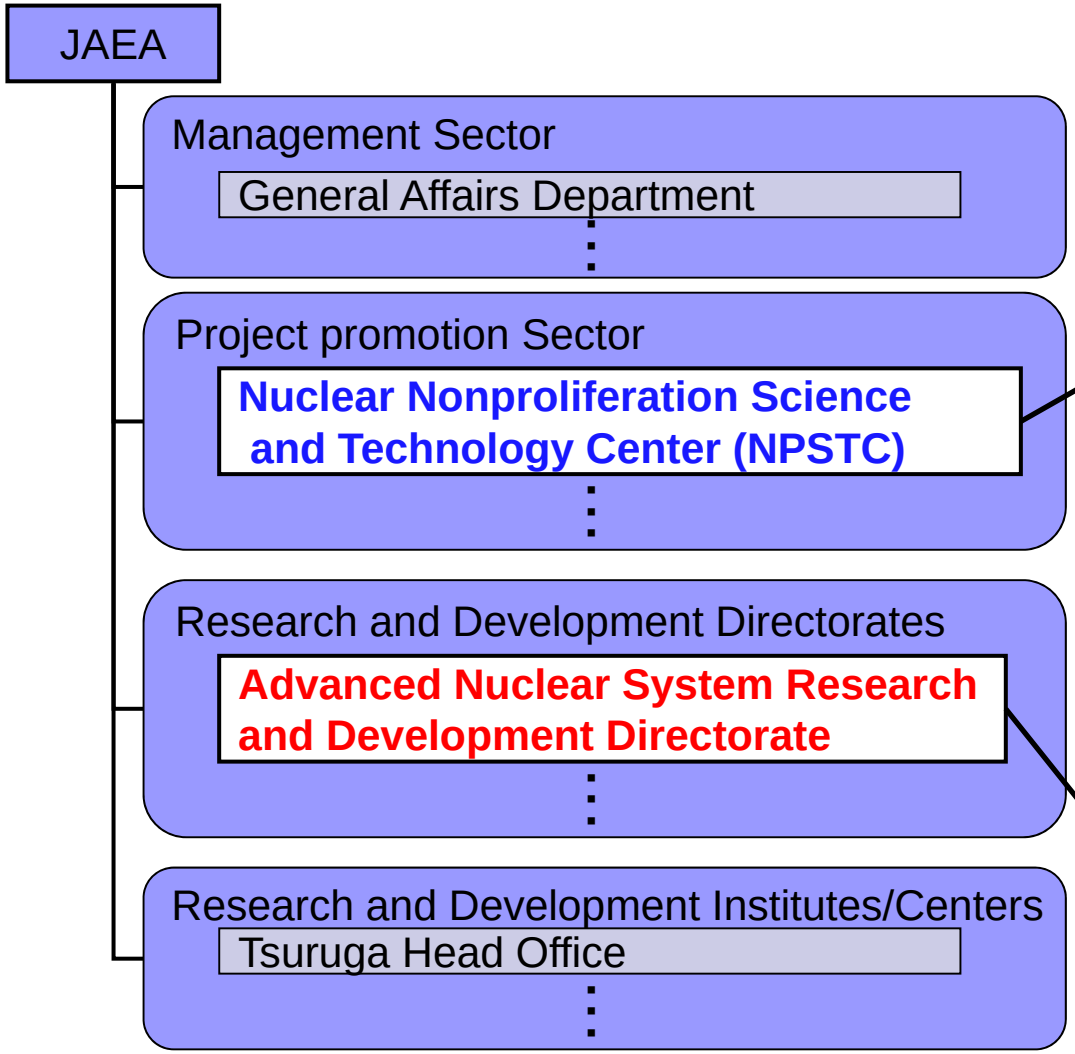
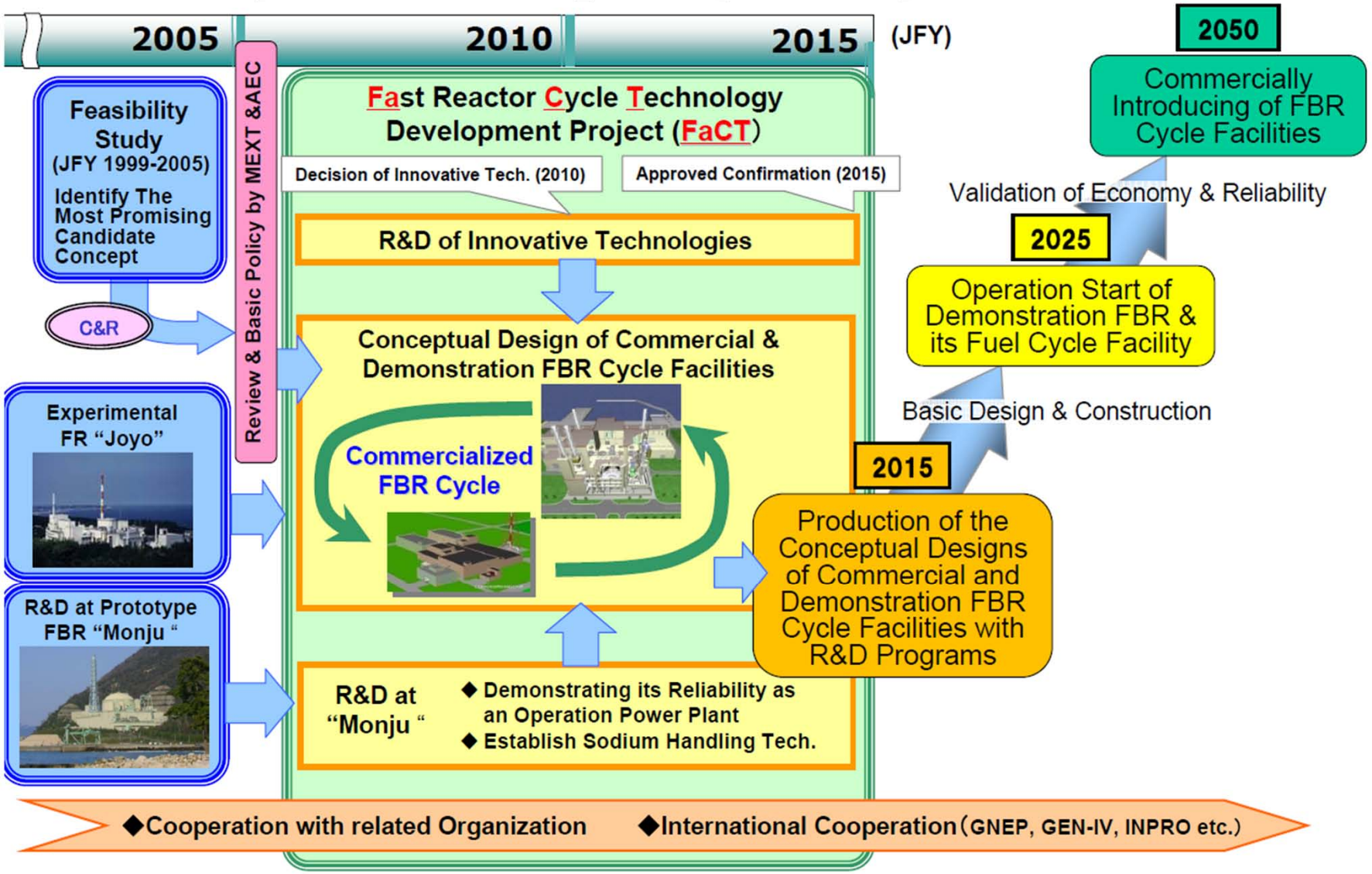
Organization related to the collaborative study in JAEA



Nuclear Nonproliferation Science and Technology Center(NPSTC) has been established to improve Japan's national nuclear material management technology and to contribute to the strengthening of the international nuclear nonproliferation regime.

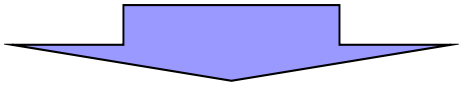
Advanced Nuclear System Research and Development Directorate mainly works on **FaCT Project**.

Fast Reactor Cycle Technology Development Project (FaCT)

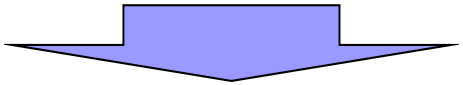


Motive of the collaborative study

- Development Target for FaCT Project
  - Safety and Reliability
  - Sustainability
    - Environmental Protection
    - Waste Management
    - Efficient Utilization of Nuclear Fuel Resources
  - Economic Competitiveness
  - **Nuclear Non-proliferation**

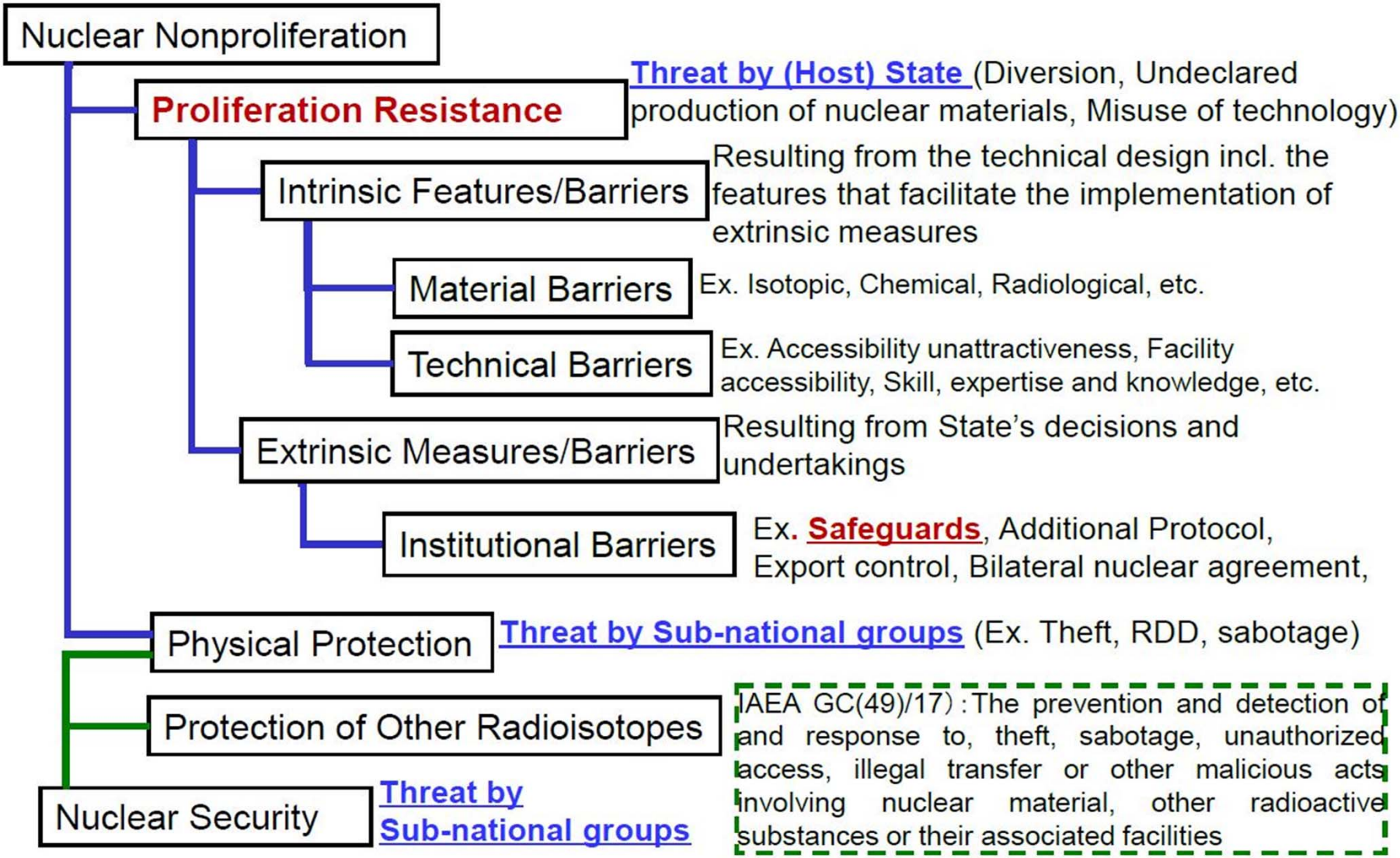


- “Non-proliferation” is one of the most important features for the future FR Cycle systems.
- However, understandings of “Non-proliferation” are not the same among countries so its target is obscure in comparison with others.



There is a need to indicate a clear target and a basic strategy of R&D to improve non-proliferation by collaborative study between PR&PP experts and developers/designers.

Structure of Terminology



Interim results of the study

1. Material Barrier (1) 3 types of FBR core design

- Core design approach to make FBR's **radial blanket** unattractive
  - Radial Blanket Free Core
  - Low-fissile Pu Loading to Blanket
    - Concept to be evaluated by Pellaud's Criteria (^{240}Pu/Pu>18%)
  - MA Loading to Blanket
    - Concept to be evaluated by Kessler's Criteria (^{238}Pu/Pu>9%)

Interim results of the study

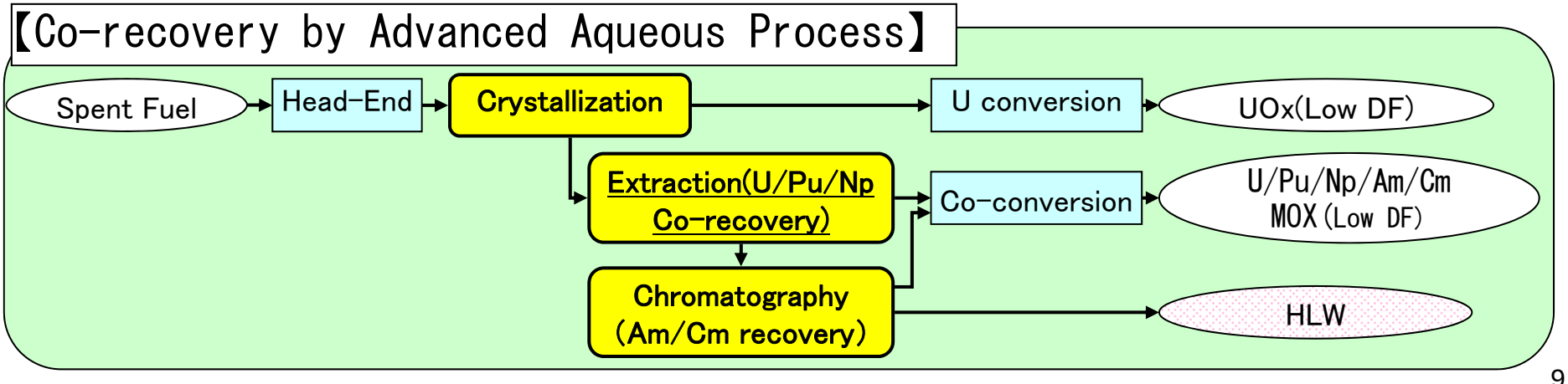
2. Material Barrier (2) Evaluation and Results

- Evaluation of Core Concept
  - Trial Design of 3 Core Concepts for :
    - Verification of the Technical feasibility
    - Evaluation of PR by three proposed criteria (Pellaud/Kessler/Bathke)
- Evaluation of Fuel Cycle Scenario
  - Consideration of FR Fuel Cycle Scenario based on the long term material mass flow for :
    - Verification of the feasibility from viewpoint of mass balance
    - Evaluation of PR features by the criteria through transition period
    - Consideration of economic competitiveness
- Results:
  - Each concept is effective to make radial blanket unattractive
  - Each concept is feasible in the view of material balance
  - Economical difference does not look so large

Interim results of the study

3. Technical Barrier

- Process without separation of Pu (by adoption of Advanced Aqueous Process / Co-processing)
  【Reprocessing / Fuel Fabrication】
- Mixing and handling core and blanket fuel to make nuclear material unattractive【Reprocessing】
- Low DF / MA loading fuel to make access harder (option)
  【Reactor / Reprocessing / Fuel Fabrication】



Interim results of the study

4. Safeguards and Safeguardability

- There is no critical unsolvable problem for an application of safeguards approach to the FBR cycle system.
- Next generation fuel cycle facility has three features related to safeguards/safeguardability.
  - 【Relatively large amount of Pu inventory】 requires below:
    - Shortening MUF evaluation periods, resulting from large error
  - 【Implementation of Integrated Safeguards】requires below:
    - Frequent declaration of total inventory
    - Quick declaration with Short Notice Random Inspection (SNRI)
  - 【Low DF / MA loaded fuel】requires below:
    - Development of technologies as the alternatives of some NDA which is difficult to be applied under existence of ^{244}Cm/FPs

Interim results of the study

5. Direction of future study and development

- Directions
  - Appropriate combination of institutional barriers, technical barriers and material barriers
  - A package of PR features/measures should be effective, economically reasonable and realistic.
  - Safeguards/Safeguardability are more important, and the other features/measures should be discussed in conjunction with them.
- Important Issues
  - Development of the technology to apply Integrated Safeguards to the fuel cycle facilities that have large amount of Pu inventory
  - Study of material barriers and technological barriers
  - Development of the accountancy technology for low DF/MA loaded fuel

Lessons learned from the study

In the view of developers/designers

- So far, developers/designers of future nuclear systems have not paid enough attention to the trends of non-proliferation.
  - *Few experiences of SBD at the early design stage.*
  - *A concept of "safeguardability" is not so familiar to the designer.*
- The GIF-PR&PP evaluation method seems to be a useful tool to point out weaknesses in the PR&PP features, however, there is a little concern about its application.
  - *How should we reflect the evaluation results to our design activity?*
    - Can we use the result to obtain international consensus about proliferation resistance of our system ?
    - What is the PR&PP criteria applicable in the design stage?
  - *Resources for implementing evaluation*
- Importance of the continuous collaboration.
  - *Practical method for SBD*
  - *Criteria or Guidelines aiming at international harmonization*