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JAEA Study on Assurance of Supply of Nuclear Fuel

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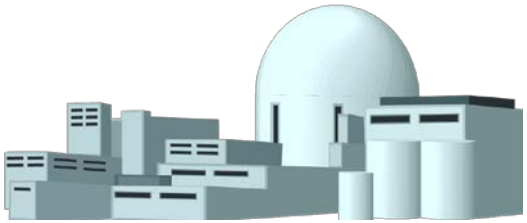
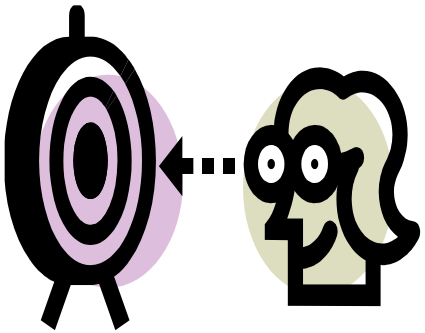
What is Assurance of Supply of Nuclear Fuels?

- **Special nuclear fuel supply arrangements in case of fuel supply disruptions caused by any political reasons other than nuclear nonproliferation reasons**

- **Back up solutions to be implemented only in the very few cases, since the fuel supply primarily rests on the existing commercial markets**





★Purpose / Background

- **Reduce proliferation risk of nuclear weapons and / or nuclear weaponization capabilities**
- **Promoting the peaceful uses of nuclear energy in the era of "nuclear renaissance"**

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Basic Principles of System Design for AOS Mechanism

- **Reality based system**
  - based on the Japanese proposal and IAEA DG's report (June 2007)
  - using IAEA fuel bank (based on NTI proposal), Russia proposed fuel bank (IUEC), U.S. proposed fuel bank (derived from HEU)
- **Expand the items to be assured in the whole front-end cycle**
  - Many countries could participate in this system as a supplier
  - This could cope with any items disruption in the front-end cycle
- **Not to disturb global nuclear fuel market**
- **System must be operated by IAEA and AOS member states**
- **Establishing the AOS system at a minimum cost**

IAEA Standby Arrangement System (Japanese Proposal : INFCIRC/683)

Countries voluntarily notify to the IAEA their supply capacity in the whole front-end cycle

- Uranium concentrate supply
- Uranium reserve supply (NU or LEU)
- Conversion service
- Enrichment service
- Fuel fabrication service

at the following three levels;

Level 1: Not exporting but has the will to cooperate. Quantity would be limited and considerable time would be needed

Level 2: Exporting and has the will to cooperate as much/soon as it can.

Level 3: Exporting and has the will to cooperate through reserve/supply capacity in a short period of time.

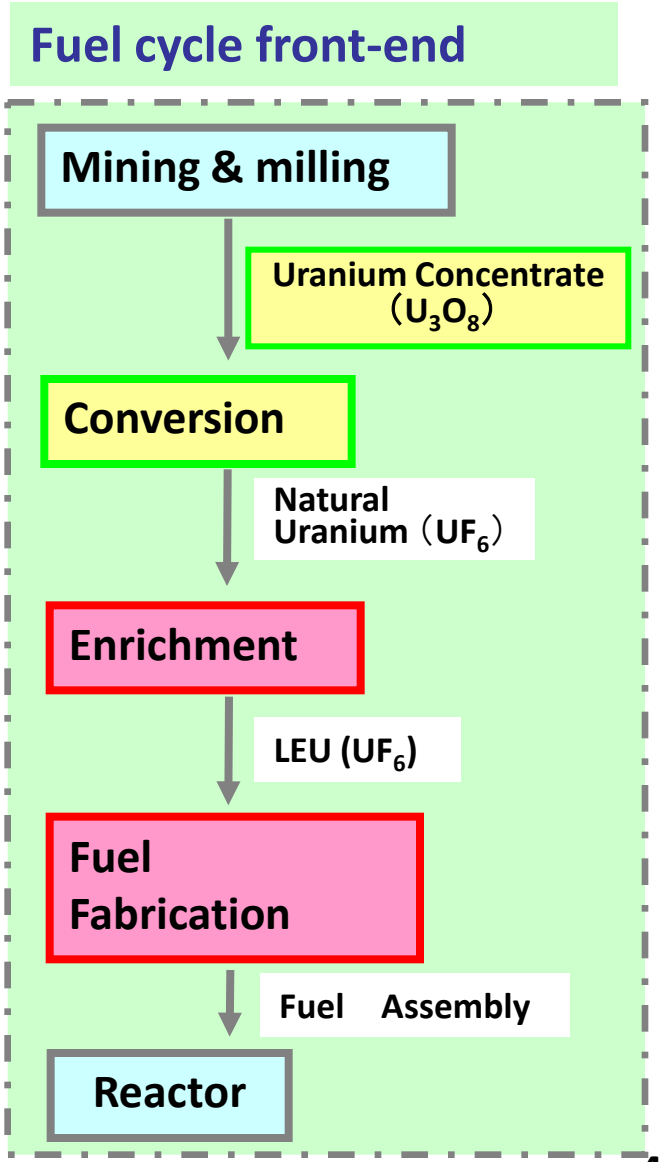
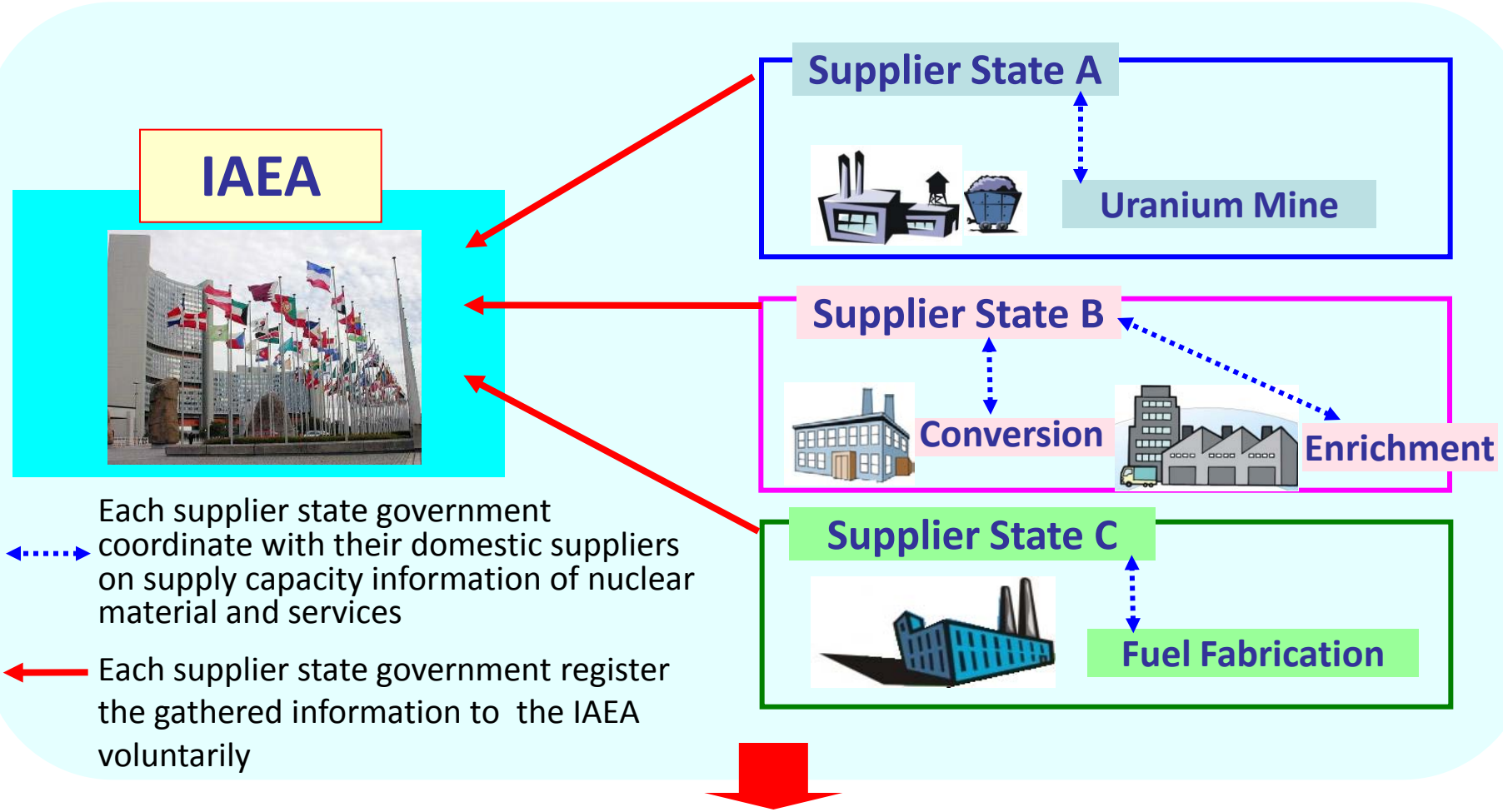


Image of Supply Capacity Registration



By enhancing the transparency of the whole front-end market, reducing the risk of supply failure

Example: Supply Capacity Registration of State X in the Year of 20XX

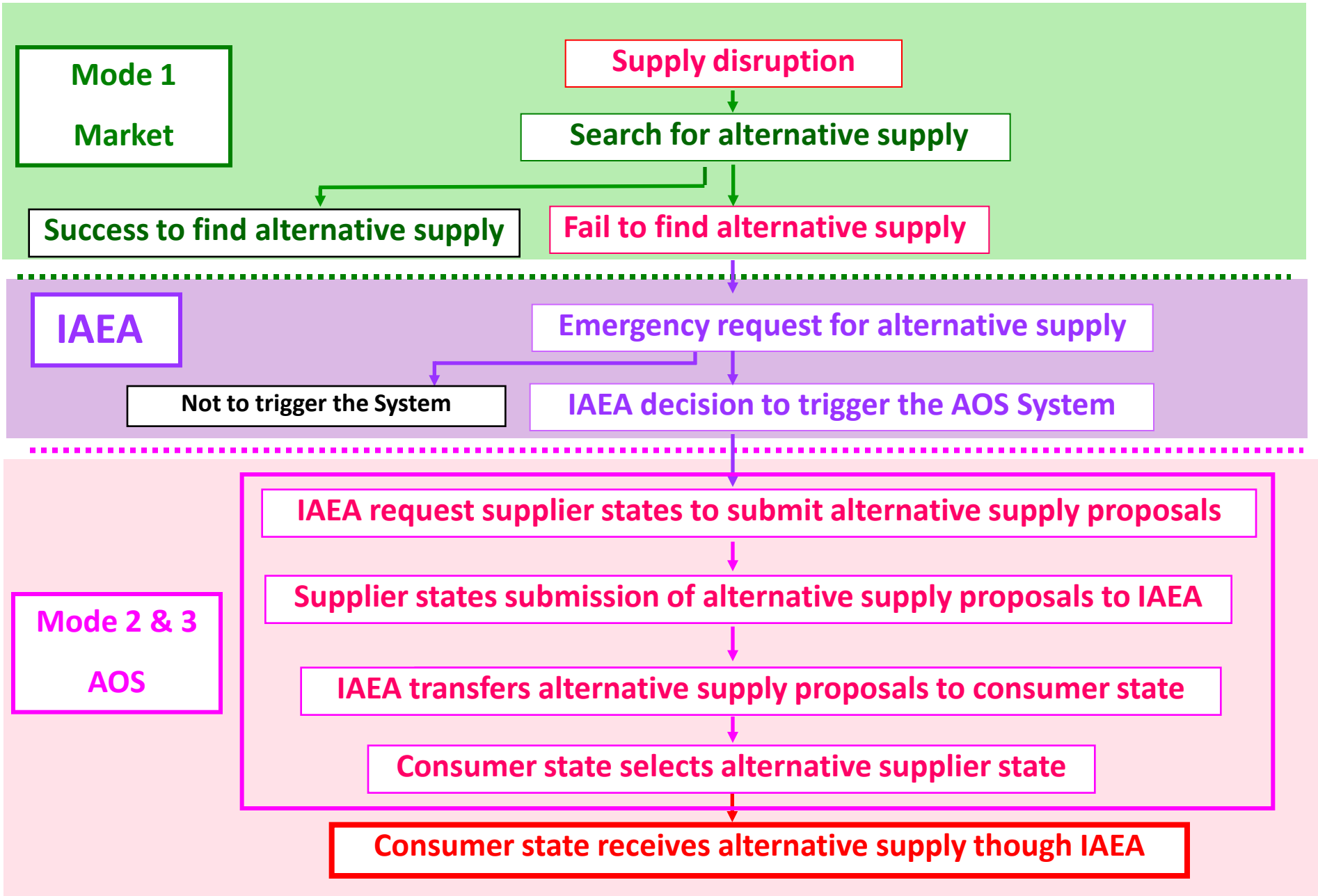
Registration Materials & Services / Registration Level	Uranium Concentrate (U_3O_8) Natural Uranium (UF_6) <*Fuel Bank*>	Conversion Service 【Design capacity: 5,000tU/y】 <*Supply Capacity*>	Enrichment Service 【Design capacity: 10,000tSWU/y】 <*Supply Capacity*>	Low Enriched Uranium (LEU) (UF_6 or UO_2) <*Fuel Bank*>	Fuel Fabrication Service 【Design capacity: BWR 500tU/y, PWR 1,000tU/y】 <*Supply Capacity*>
Level 1 Not exporting but has the will to cooperate. Quantity would be limited and considerable time would be needed	U_3O_8 200～300tU (12 months)	----	----	----	----
Level 2 Exporting and has the will to cooperate as much/soon as it can.	----	----	----	UF_6 30～50tU (9 months) *(Virtual Reserve)*	----
Level 3 Exporting and has the will to cooperate through reserve/supply capacity in a short period of time.	----	100tU (3months)	200tSWU (3 months)	UO_2: 30tU (1 month)	BWR: 20tU PWR: 50tU (6～9 months)

JAEA Proposal

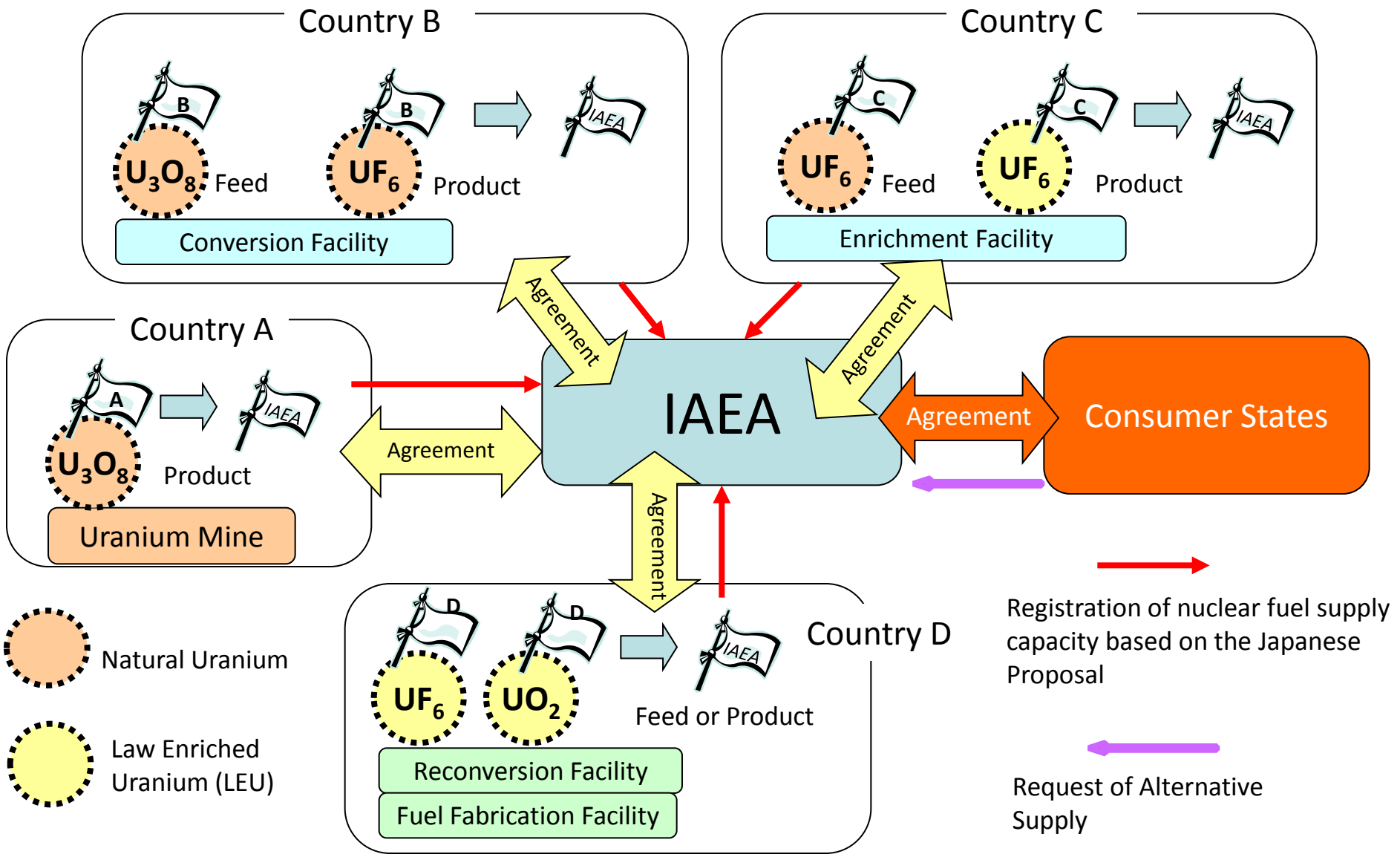
Re-Arrange and Re-Define Three Levels into Three Modes

Modes 1-3 (JAEA Approach)			Levels 1-3 (IAEA Director- General's Report**)	
Fuel/ Services to be assured	U3O8、LEU、 conversion・enrichment・ fuel-fabrication service		LEU、fuel assembly	Fuel/ Services to be assured
Mode 1	Commercial market		Commercial market	Level 1
Mode 2		Mode 3	● LEU : Backup commitments by suppliers and their respective Governments ● Fuel fabrication: commitments by supplier States	Level 2
Virtual fuel reserve/ Virtual services Backup commitments by suppliers' respective governments Supply of U3O8 UF6 LEU conversion service enrichment service fuel fabrication service		Fuel bank/ a physical reserve Supply of U3O8 UF6 LEU	● LEU : a physical LEU reserve, stored in one or several separate locations ● Fuel fabrication : a set of agreements between fuel manufacturers and owners of relevant intellectual property rights	Level 3

Flow Chart of Mode 1 to 3



Mode 2 : Material/Service Supply System



Mode 2 : Case Study of Enrichment Service Supply

Premises:

- Enrichment service for 1 reload fuel (194tSWU) for a PWR "A" was disrupted fuel supply.
- An alternative enricher "N" with 3,000tSWU/year capacity, which provides an alternative supply.

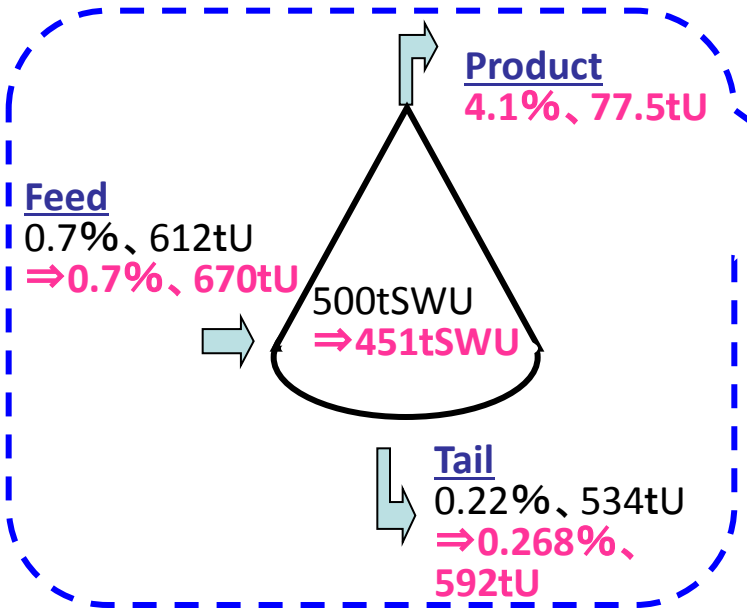
Alternative Supply:

- "N" provides the supply by reducing other customers' SWU, but not delaying the delivery of enriched UF6.
- "N" reduces other customers' SWU by increasing feed amount and tail assay.

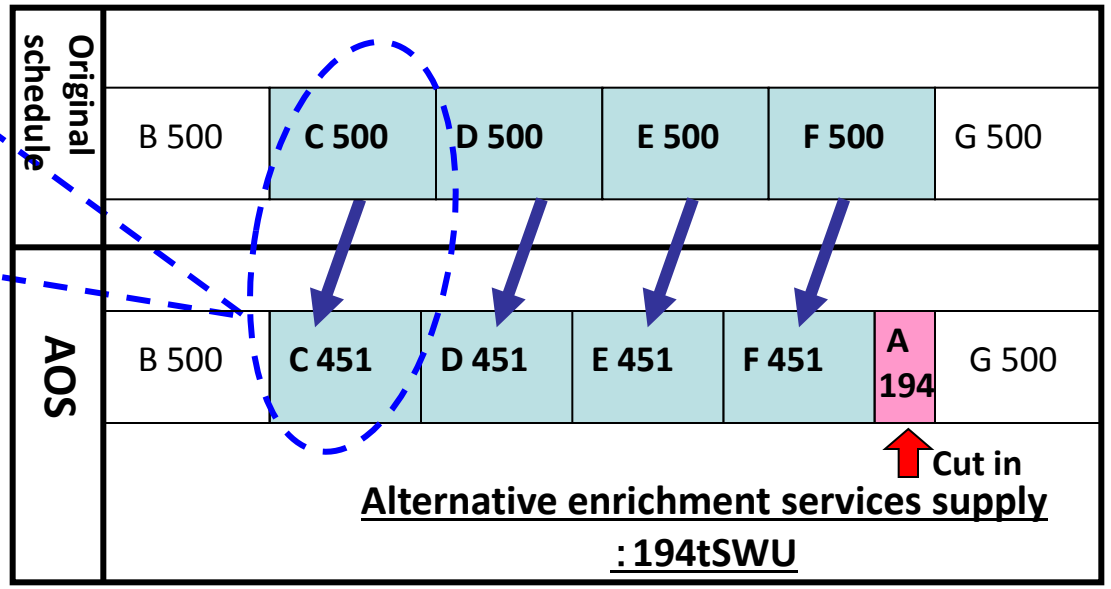
Additional cost: Approx. $4mil.

- Natural UF6 (232tU) purchase cost: approx. $35 mil.
- Increased income by uranium enrichment service for "A": approx. $31 mil.

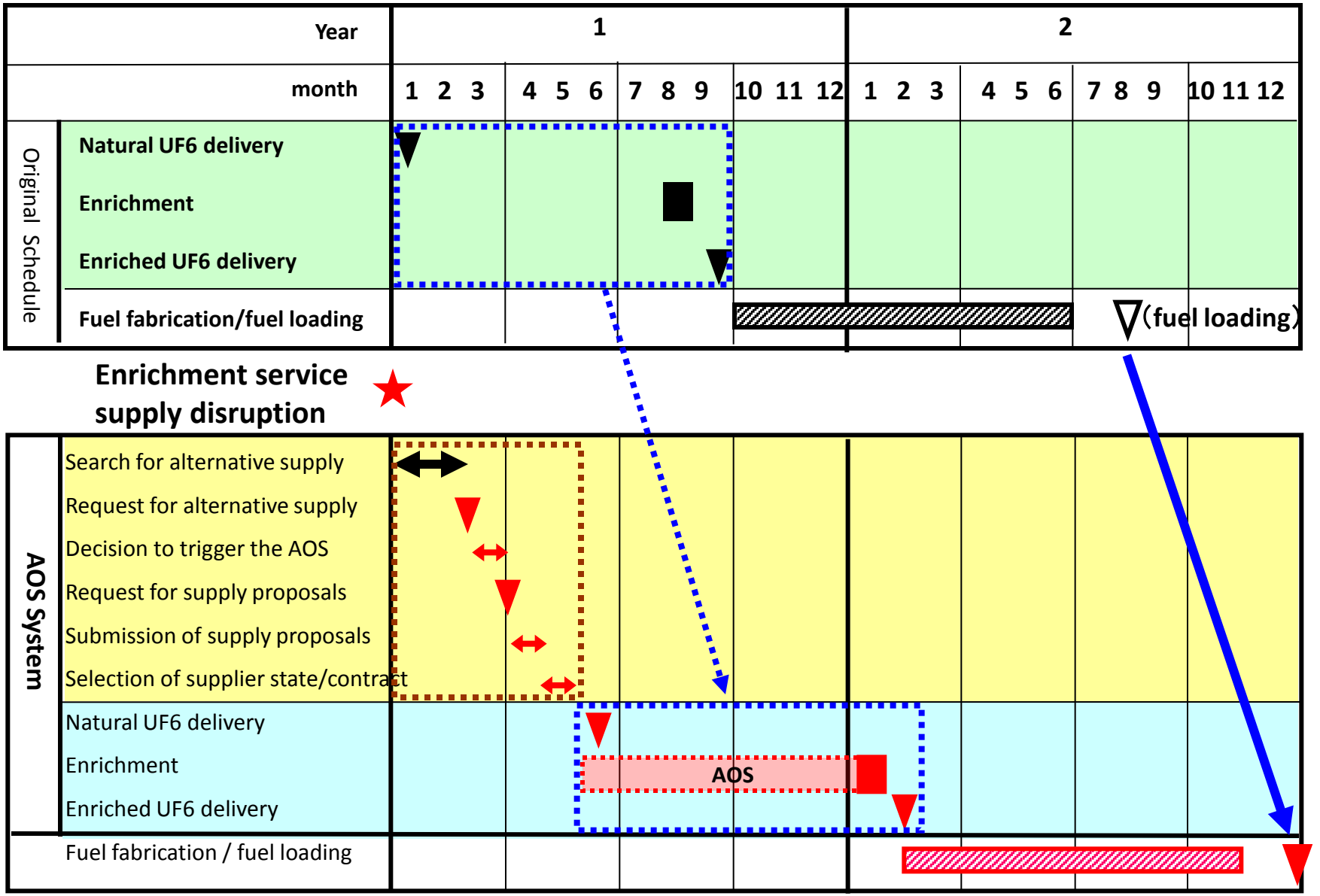
*As of April 2009



unit : tSWU



Mode 2 : Case Study of Time Table



Mode 2: Case Study of Fuel Fabrication

- **Premises:**

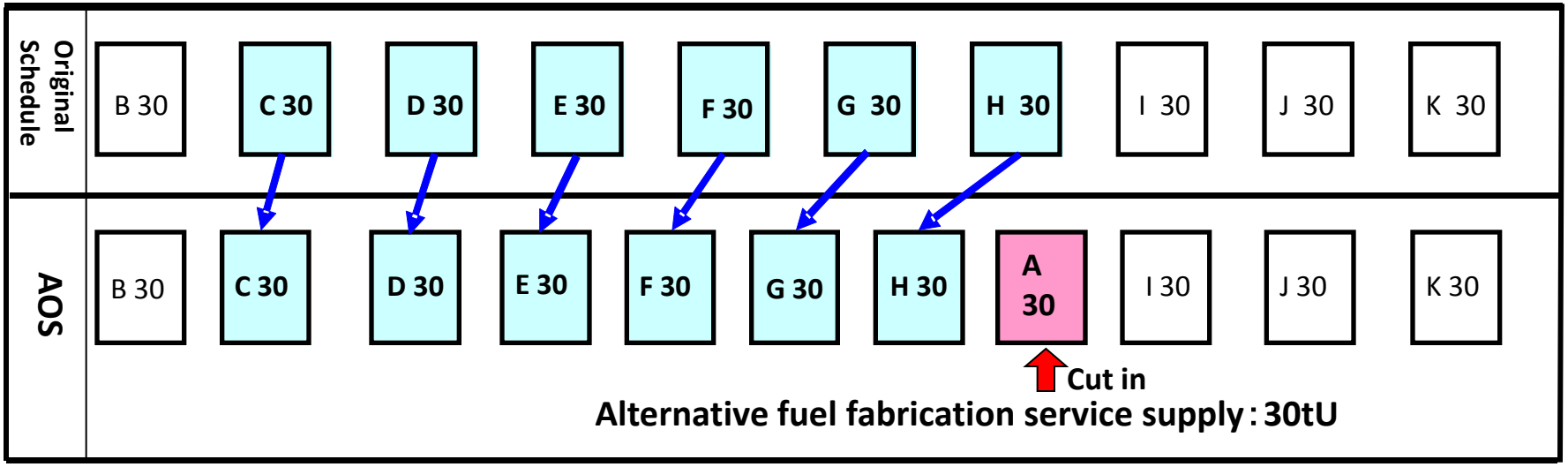
  Fuel fabrication service for 1 reload fuel (65 fuel assemblies, equivalent to 30tU) for a PWR "A" , which was disrupted fuel supply.

  An alternative fuel fabricator "N" with 400tU/year production capacity (equivalent to 850 fuel assemblies) provides an alternative supply.

- **Alternative Supply:**

  "N" provides the supply by raising operation rate of its fabrication facility, but not delaying other customers' fuel delivery.

unit : tU



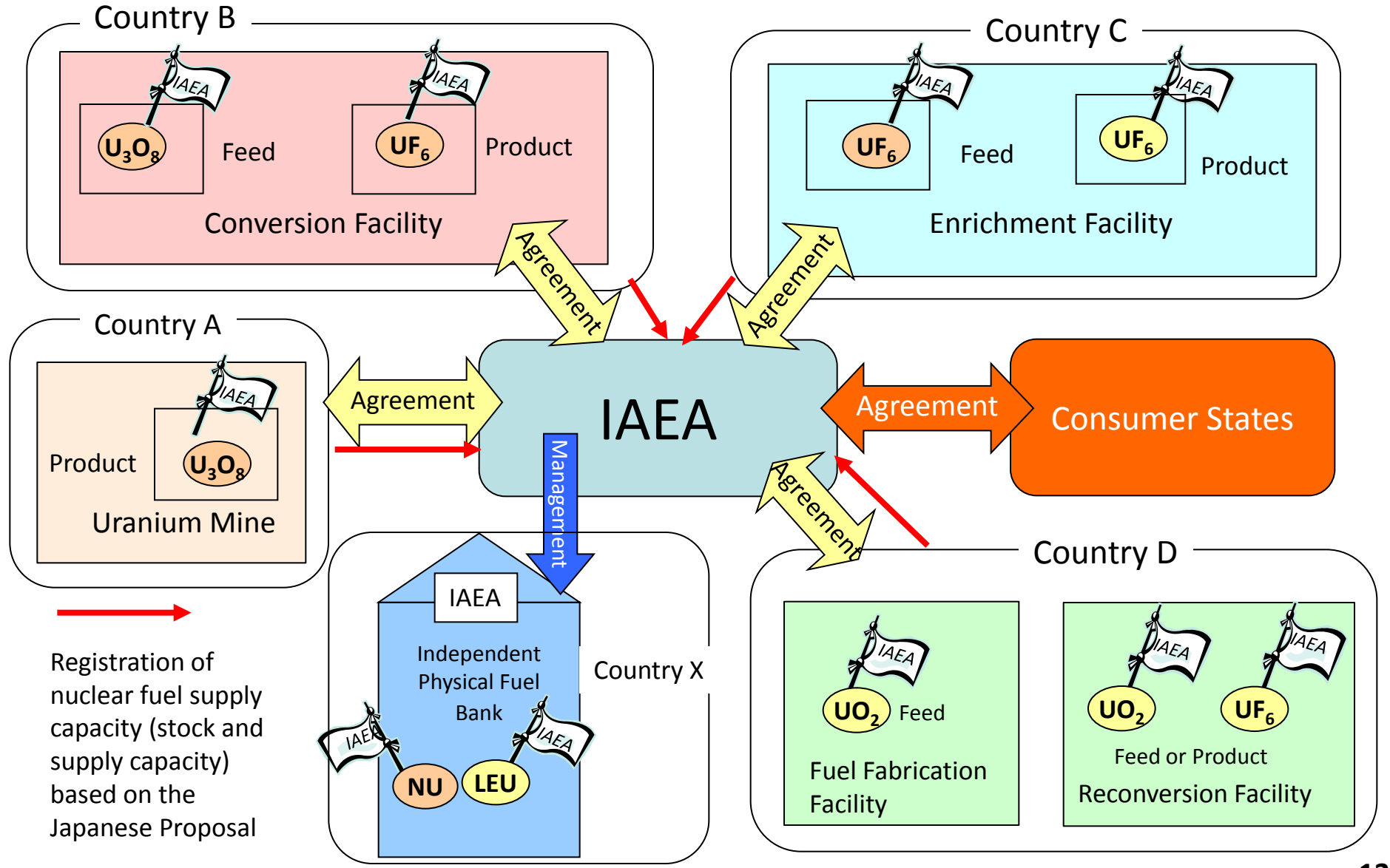
- **Additional Cost: Approx. 400 – 800 mil. yen (approx. $4 - $8 mil.)**

  Additional cost=$275/kgU*x 30tU x(50% ～ 100%)

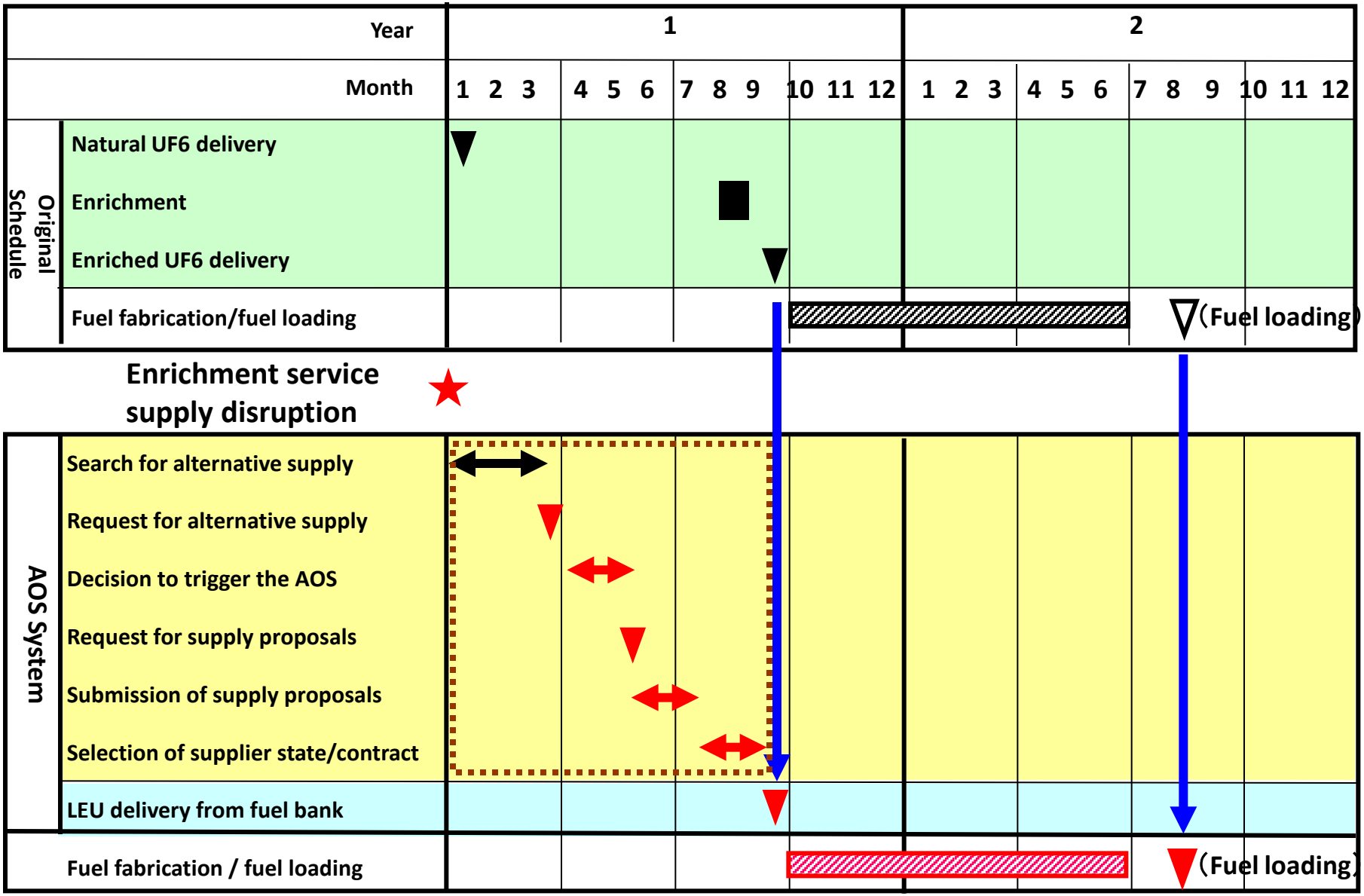
  ***Fuel fabrication service unit price:**

  Source : MIT Report: The Future of Nuclear Power (http://web.mit.edu/nuclearpower, 2003)

Mode 3 : Alternative Supply from Fuel Bank



Mode 3 : Case Study of Time Table



Summary

- ✓ JAEA proposed AOS system and evaluated its feasibilities by various case studies.
- ✓ We re-arranged and re-defined multilayered AOS system as Mode 1 to 3.
- ✓ In terms of operation cost of AOS, Virtual fuel reserve/services of Mode 2 has advantage.
- ✓ Physical fuel bank would give great relief to consumer countries.

JAEA will continue our study and would like to contribute the international discussion of AOS.


Thank you for your kind attention