

Spent Nuclear Fuel Issues in Korea: Multinational Options

Miles A. Pomper
Senior Research Associate
CNS, Monterey Institute

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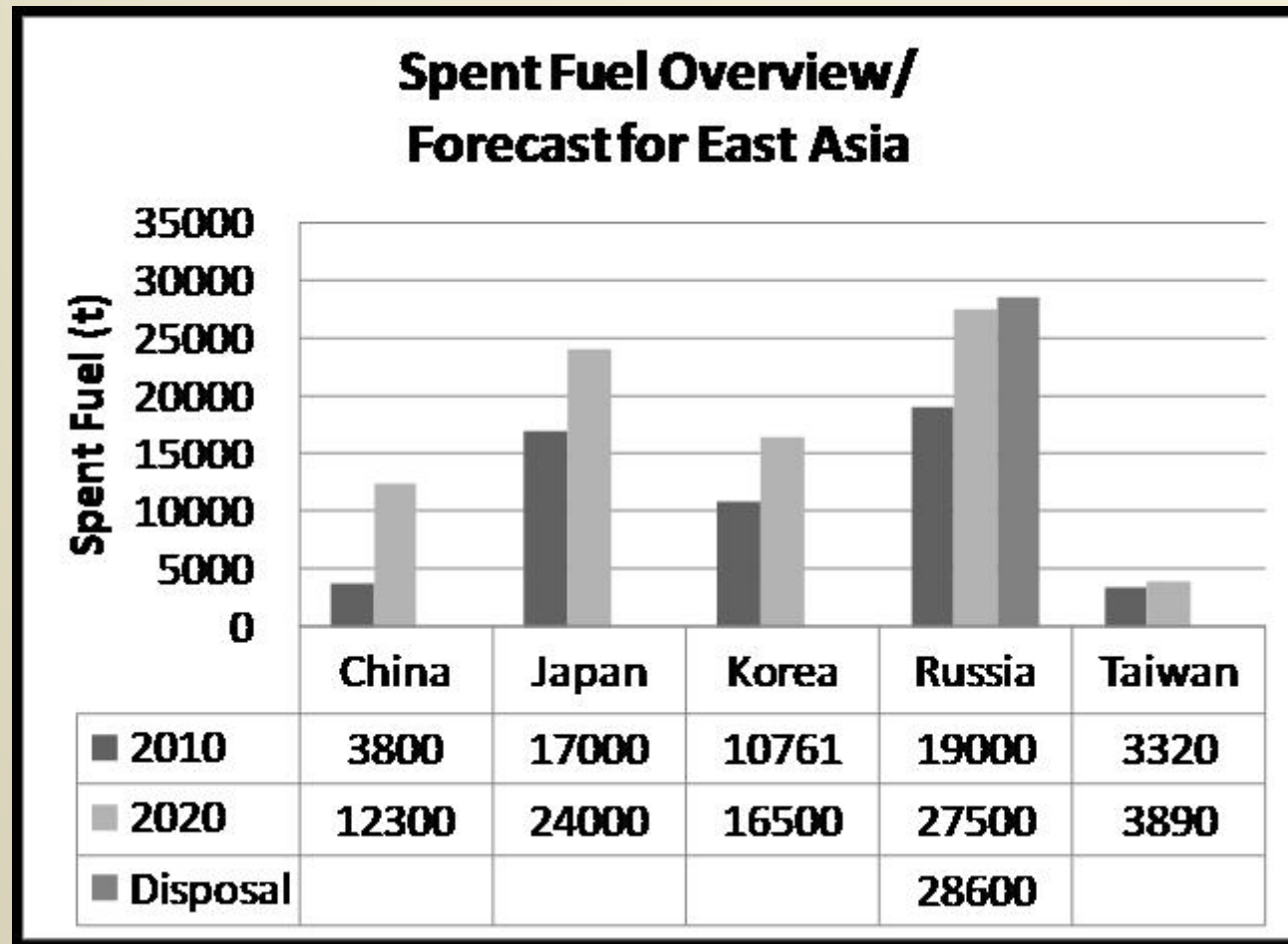
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Photo: Idaho national lab

Why a Multinational Option? (1)

- ❖ Multinational control of nuclear facilities long been a goal of nonproliferation advocates
 - ❖ Belief it would make it harder to use such facilities for nuclear weapons purposes (i.e diversion)
 - ❖ Means additional monitoring beyond IAEA safeguards
 - ❖ Raises confidence of neighboring states
 - ❖ Particularly important for sensitive facilities, E & R
- ❖ Eliminates distinction between have and have-nots
 - ❖ Reduces commercial, prestige considerations
- ❖ Several attempts over the years to move to such control
 - ❖ 1946 Acheson-Lillienthal report
 - ❖ 1970s: Regional fuel cycle centers, international spent fuel storage system, international nuclear fuel cycle system
 - ❖ 2000s: ElBaradei formed IAEA expert group report renews call

Why a Multinational Option? (2)



Why a Multinational Option? (3)

Provides path ROK and US might agree on in 123 talks:

- ❖ Other options are difficult for either US or ROK
 - ❖ Winning domestic public support for interim storage and permanent repository difficult for ROK, absent “permanent solution” to waste
 - ❖ U.S. doesn't want to support national pyroprocessing facilities—one current ROK option
 - ❖ U.S : pyroprocessing=reprocessing
 - ❖ Doesn't want to see spread of reprocessing facilities to new countries
 - ❖ Sees pyroprocessing as violation of North-South denuclearization agreement
 - ❖ Worries about China, DPRK, Japan reaction to any ROK facility

Potential Multinational Options(1):

Interim Storage or Permanent repository outside ROK:

- ❖ Best from a nonproliferation point of view
- ❖ Long-Term interim storage:
 - ❖ Gaining International Support (2011 MIT Study, ? Upcoming US Blue Ribbon Commission report)
 - ❖ Provides time for study of various new reactor/spent fuel decisions (MIT)
 - ❖ Economic advantages
 - ❖ Waste advantages
 - ❖ If sufficiently long storage (100 years as permitted by NRC) ultimate repository requirements are significantly reduced
- ❖ Preferred locations: China or Russia or enriched uranium suppliers (France, US etc)
 - ❖ China, Russia: Available land, NWS, nearby (lower shipping costs)
 - ❖ Some ctys (Russia) have nuclear cooperation agreement with US should permit this
 - ❖ But would they support it?
 - ❖ More likely for interim storage than repository (Not quite “Cradle to Grave”)
 - ❖ Many previous attempts to initiate regional sites have failed
- ❖ U.S. and Japan have studied possibility of Mongolia
 - ❖ Not clear if Mongolia supportive (most banned by current law)
 - ❖ No infrastructure (physical or legal) and landlocked

Potential Multinational Options(2):

PUREX reprocessing in France or UK

- ❖ 2009 U.S–UAE nuclear cooperation agreement provides UAE with this possibility vis France and UK
 - ❖ But requires separated plutonium to remain in those countries
 - ❖ Would also serve effectively as interim storage until reprocessed
- ❖ PUREX reprocessing is expensive
 - ❖ Would ROK have to pay shipping and other costs and not get fuel back?
 - ❖ France already has too much separated plutonium for commercial interest (MOX expensive)
 - ❖ Given distances, shipping costs would be high
 - ❖ But Pu separation greater U.S. concern in closer alternatives (Japan, Russia)
- ❖ ROK would still have to accept high–level waste
 - ❖ Doesn't lessen ultimate disposition problems significantly
 - ❖ Better alternative than interim storage?
- ❖ MOX safety concerns
 - ❖ Heightened by Fukushima crisis

Potential Multinational Options(3):

Multinational Advanced Reprocessing Facility in Russia, China, or United States

- ❖ Would achieve nonpro. benefits of a multinational facility
 - ❖ Could also provide a test bed for strengthened verification technologies and practices, set standards for such facilities, co-locate with experimental reactors?
- ❖ Placing such a facility in NWS would reduce possibility for ROK to employ a clandestine reprocessing facility tied to open pyroprocessing facility
- ❖ Questions:
 - ❖ What happens to product of facility—ie “recycled material”
 - ❖ Potential proliferation problem
 - ❖ What happens to waste from this process?
 - ❖ Significantly reduced, but not eliminated. Who takes it—pyro site or ROK?
- ❖ Economically viable?
 - ❖ Have to pay shipping costs for fuel (very high with US), deal with waste + high and uncertain costs of pyro facilities and building fast reactors
- ❖ Politically viable?
 - ❖ Not as much interest in these countries in pyro as in ROK
 - ❖ But U.S pioneered technology
 - ❖ How much control would ROK have over facilities, use of product?

Potential Multinational Options(4):

Multinational Experimental Fuel Cycle Facility in ROK

- ❖ Could still meet many of the requirements of U.S. and international nonproliferation law
 - ❖ To do so would need to not be seen as a *national* facility
 - ❖ Depends on participation and conditions related to ownership, governance, access to technology, territoriality
- ❖ Might provide a “permanent solution” to allow interim storage at site and reactor sites.
 - ❖ Site might also serve as final repository
- ❖ Opportunity to experiment with technology in cooperation with neighbors
 - ❖ MIT study: Too early to lock in one technology
 - ❖ But too expensive for any one country to test them all (including US)
 - ❖ Would build on efforts like Gen IV
 - ❖ Could build on 10-year feasibility study that US and ROK agreed to this year
 - ❖ Study looking at pyroprocessing and other approaches to spent fuel
 - ❖ A pilot pyroprocessing facility could be one option

Key Questions for a facility in ROK (1)

- ❖ Need to study practical questions
 - ❖ Some very general notions/models–
 - ❖ IUEC (Angarsk)
 - ❖ German Multinational Enrichment Sanctuary (Cochran/Paine proposal)
 - ❖ URENCO
- ❖ **Governance**—What is the ownership structure of the facility? Technology? Product? Government or private sector? Who makes decisions about buying and selling relevant materials (including spent fuel/product)? How would liability issues be handled? Taxation?
- ❖ **Safeguards and IAEA role**– What kind of IAEA safeguards should apply? How would they be monitored? Would the new entity require its own safeguards agreement? More broadly what should be the IAEA's role with the new facility and its interaction with ROK?
- ❖ **Technological sensitivity and access**—what particular technologies might be involved in such a facility and what are their relative sensitivities? Who should have access to them and under what conditions? What technological alternatives might be considered and what are their relevant proliferation risks?

Key Questions for a facility in ROK (2)

- ❖ **Dealing with inputs and outputs**– Will Koreans accept importing spent fuel from other countries? What kind of inventory should such a facility have of spent fuel and product? What should be done with the product—ie how does this interact with potential fast or other reactors and where should those be located? What are proliferation concerns about fast reactors and how should those be addressed ?
- ❖ **Participation, legitimacy, and regional cooperation:** Who are key players? In what way do they participate? What would it take for a multinational facility to gain legitimacy from US, Japan, China, other key players? To become a global model? How can this tie in to other regional efforts to deal with the back end of the fuel cycle? What conditions need to be met to comply with US law, win U.S approval for a separate 123 agt etc. ? How make this consistent with denuclearization agreement? How tied to US–ROK feasibility study?
- ❖ **Regulation**– Who is responsible for safety and security regulation and protection for the facility? What standards should apply?

Key Questions for a facility in ROK (3)

- ❖ **Waste management**—how does one deal with waste products from facility? A Who is responsible for them? What waste streams are involved? Given imminent crisis how does facility address this, tie into other measures to handle spent fuel (ie interim storage)?
- ❖ **Broader market context**– How does this fit in with Korea's broader nuclear and other energy plans? Does this make political and/or financial sense? At what scale? When? What are potential alternatives/opportunity costs? How do they compare in terms of potential public acceptance?

Some Additional Multinational Options for ROK

- ❖ Cooperative fast reactor research
 - ❖ Expensive and risky to build such reactors
 - ❖ A number of countries in region (China, Japan, ROK, Russia) studying them, No point in having advanced reprocessing (pyroprocessing) without them
 - ❖ Recent studies have questioned whether sodium fast reactors—i.e. ROK plans-- are appropriate—
 - ❖ US and ROK could consider having more ROK involvement with Japan or French SFRs and have ROK study other reactor options reactors building alternatives—hard spectrum LWRs or Fast reactors with LEU not TRUs—could locate at potential pyro site.
- ❖ DUPIC
 - ❖ China interested in replicating technique first developed by ROK to turn LWR spent fuel into CANDU fuel
 - ❖ Perhaps China could use some ROK fuel as well.