

The Potential for and Challenges Facing Geologic Disposal of Spent Fuel in the ROK

Jungmin KANG
Visiting Professor, KAIST

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National Policy on Spent Fuel

- At its 253rd meeting in 2004, the Atomic Energy Committee (AEC) announced that national policy for spent fuel management would be decided later in consideration of progress of domestic and international technology development, and that spent fuel would be stored at a reactor site by 2016 under KHNP's responsibility.
- Since the ROK has not decided whether to directly dispose of or recycle spent fuel, currently, it has no national plan on geologic disposal of spent fuel either.

Status of Disposal System Development

- A long-term R&D program for spent fuel disposal was started in 1997.
- The Korean Reference spent fuel deep geological disposal System (KRS-V) for PWR spent fuels and CANDU spent fuel.
 - Developed at the end of 2006.
 - The depth of the repository is assumed to be 500 m.
 - The assumed amount of spent fuel from 24 PWRs and 4 CANDUs are 20,000 tHM and 16,000 tHM, respectively, assuming cooling times of 40 and 30 years for PWR and CANDU spent fuel, respectively.
 - The dimensions for the PWR and CANDU canisters.
 - The outer diameter of 1.02 m
 - The length of 4.83m
 - The weight of approximately 25 t, including the spent fuel
 - Including 4 assemblies for PWR spent fuel
 - Including 297 bundles for CANDU spent fuel
 - The distance between the parallel tunnels is 40 m, while the distance between two deposition holes for the PWR canisters is 6 m and for the CANDU canisters is 4 m.
 - Conclusion of a KAERI study: "Though no site for the underground repository has yet been specified in Korea, a generic site with a granitic rock is considered for the reference HLW repository design."

Status of Disposal System Development (cont)

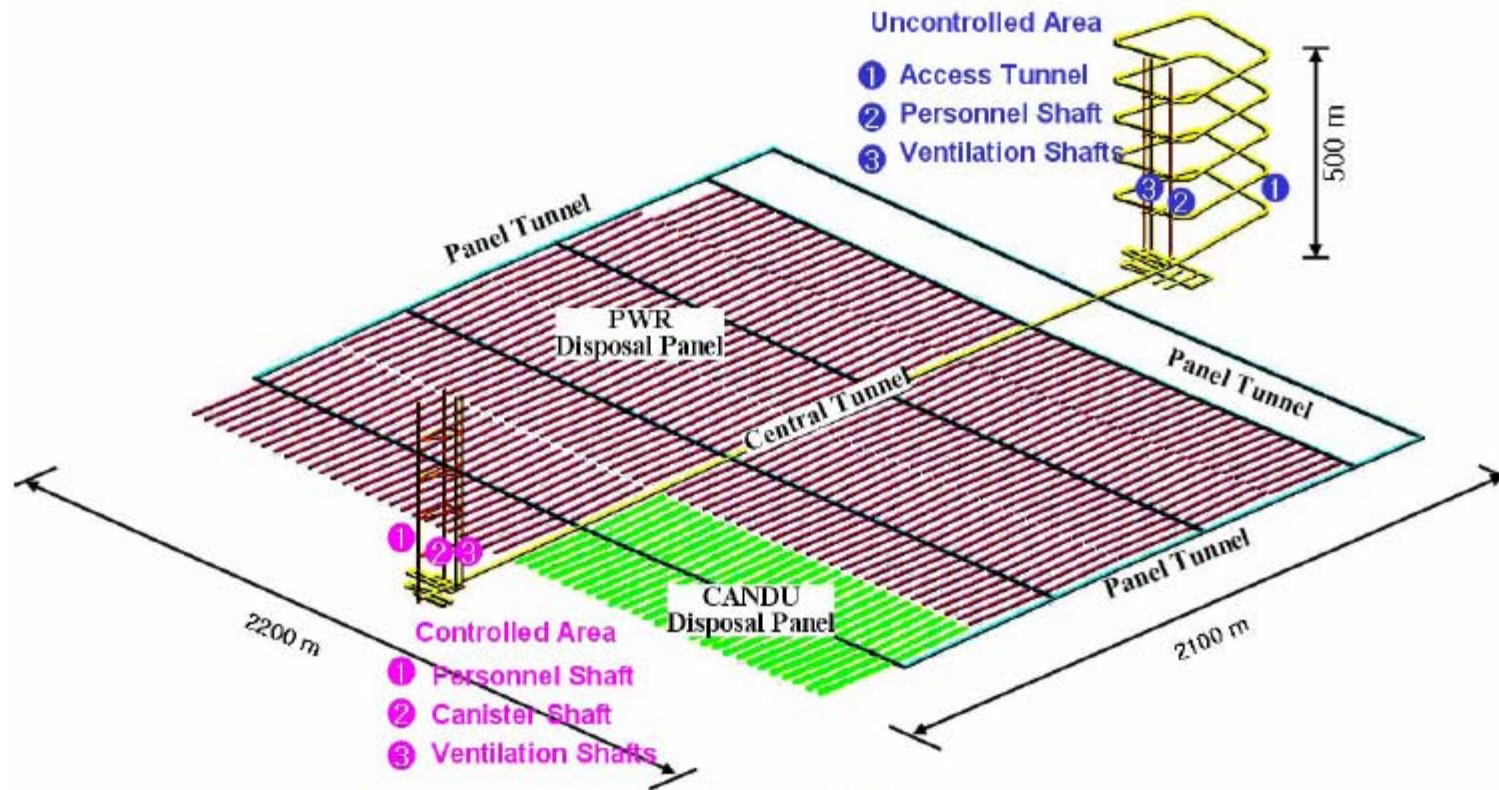


Figure 1. Layout of the Korean reference HLW Vertical disposal system.
(Green panel is for CANDU canisters.)

(Quoted from a reference)

Status of Disposal System Development (cont)

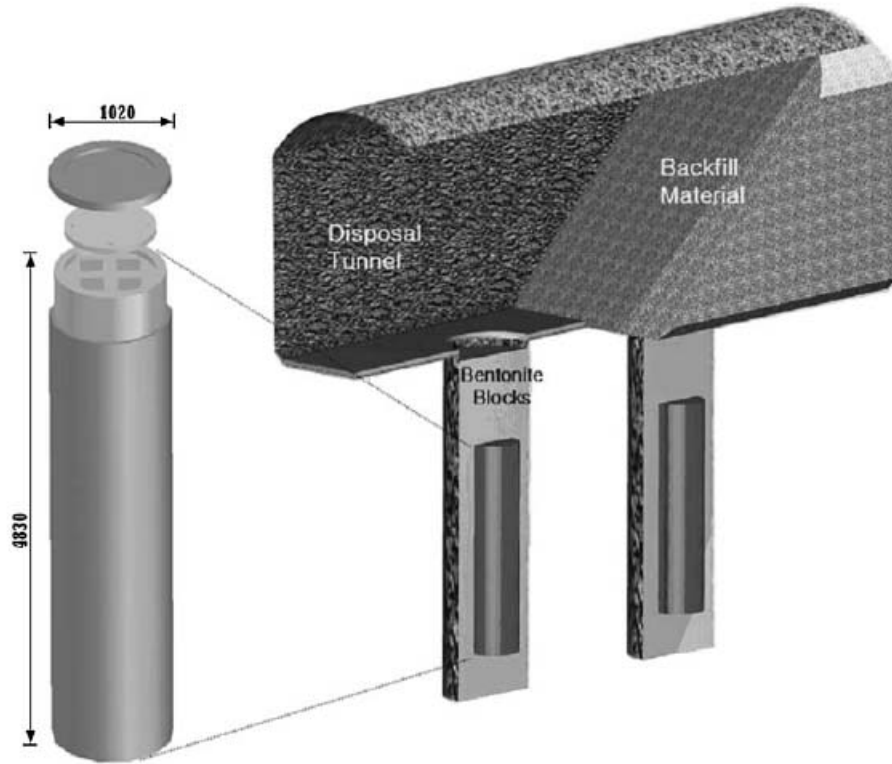
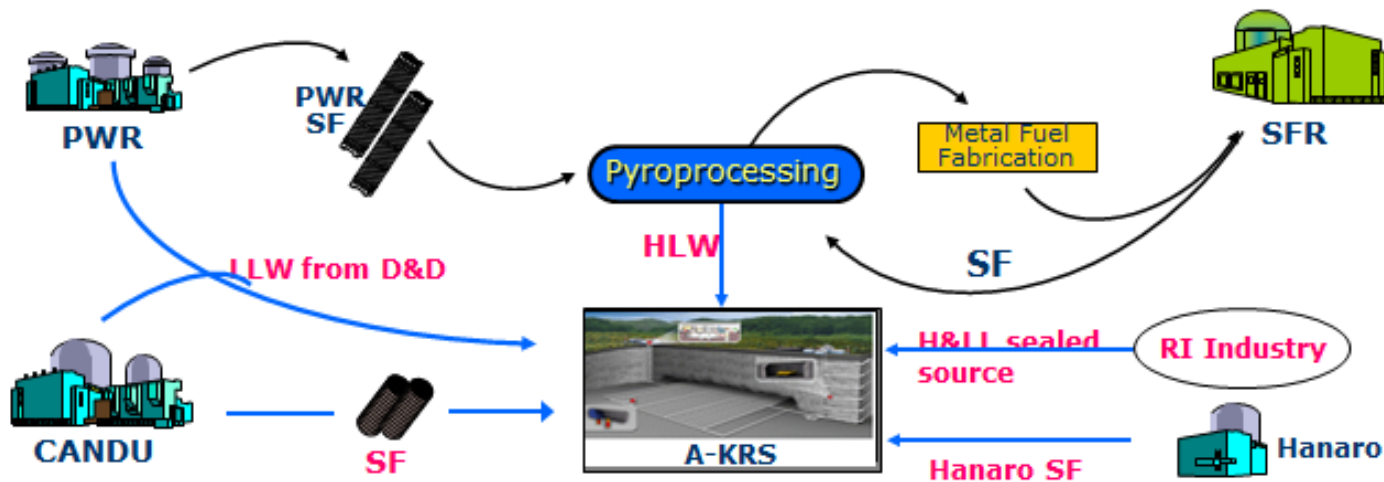


Fig. 1 Concept of a disposal canister and an engineered barrier of KRS-V1

(Quoted from a reference)

Status of Disposal System Development (cont)

- Advanced Korean Reference disposal System (A-KRS)
 - Integrated disposal system to accept various HLW/LLW generated from pyroprocessing;
 - Pre-conceptual design of A-KRS for 2007-2011.



(Quoted from a reference)

Status of Disposal System Development (cont)

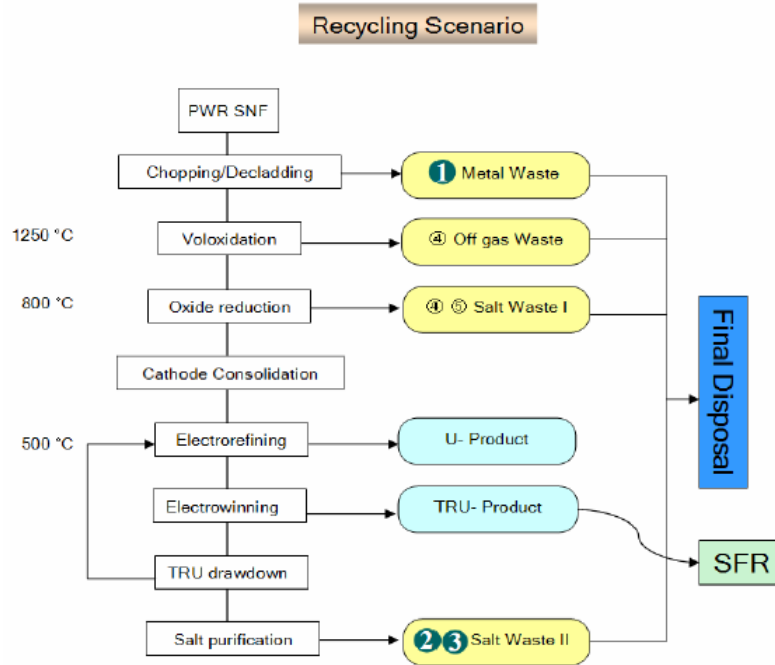


Figure 3. Recycling Scenario for the PWR spent fuels

(Quoted from a reference)

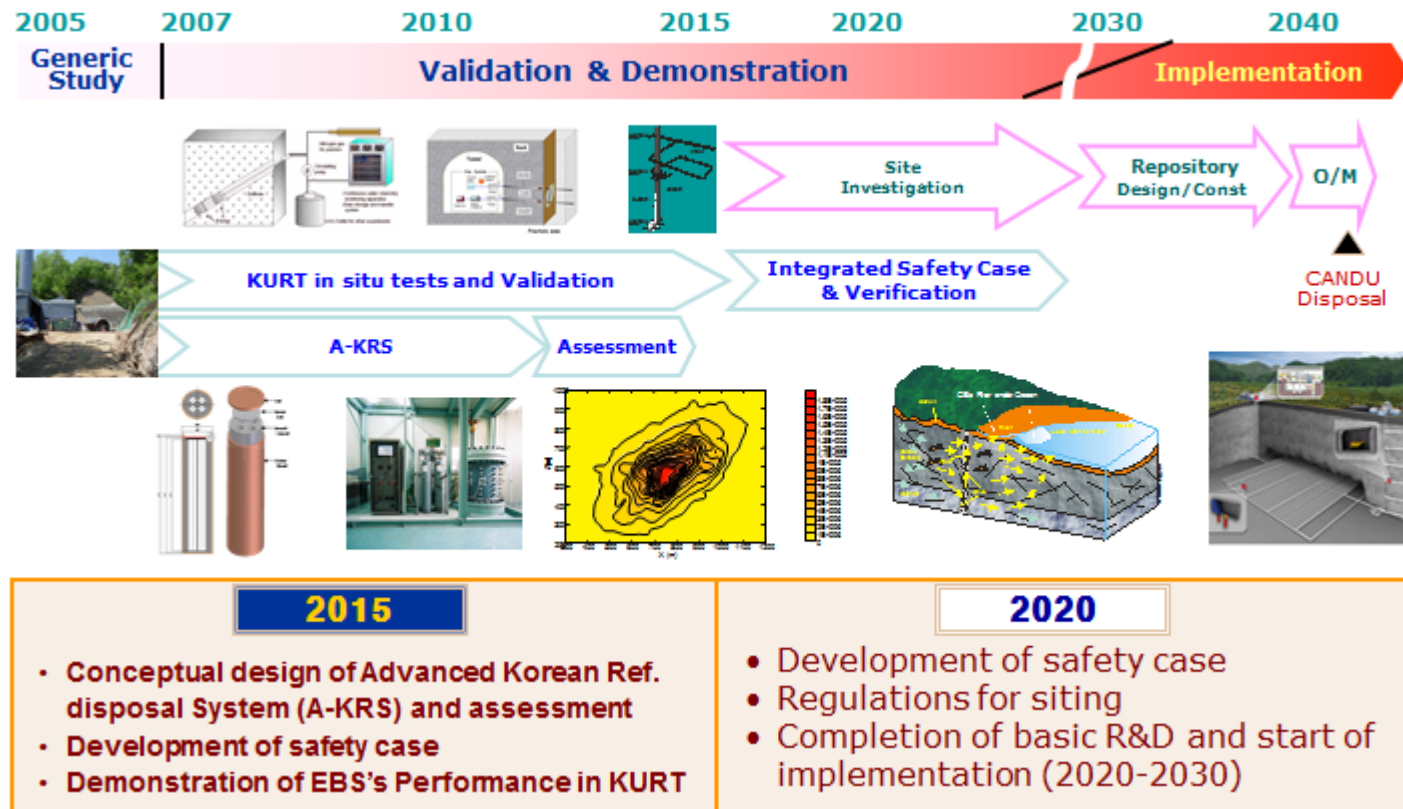
Table 1. Characteristics of the wastes from the pyro-process of PWR spent fuels

	Long-Lived Waste			Interim decay Waste	
	Metal	Ceramic $LiCl+KCl$	Vitrified $LiCl+KCl$	Ceramic $off-gas+LiCl$	Vitrified $LiCl$
Major nuclide	NM+U+TRU+RE	Cs+α	Sr+TRU+RE	Cs	Sr
Weight (kg)	3,158.53	0.65	936.21	600.94	67.99
Volume (L)	470.7	0.3	419.8	231.8	30.5
Heat (W)	-	0.9	4,200 (49.3 after 100 yrs)	12,500 (6.72 after 300 yrs)	6,000 (4.23 after 300 yrs)
Container	①	②	③	④	⑤
Disposal Depth	200	500	500	200	200
Disposal Methods	Silo or Tunnel	With waste ③	KRS or Cavern	Tunnel Storage and then final disposal	Tunnel Storage and then final disposal

→ 10MTHM of oxide fuel with 4.5 wt% U-235. 45,000 MWD/MTU, 5 yrs cooling

Status of Disposal System Development (cont)

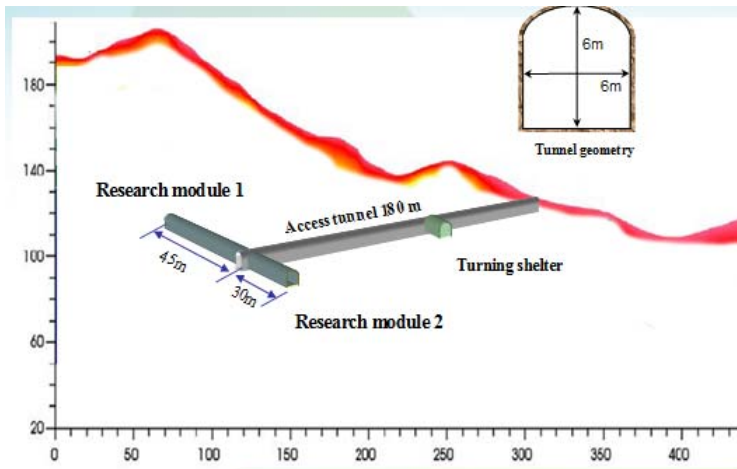
- Long-term R&D Plan for HLW Disposal



(Quoted from a reference)

Status of Disposal System Development (cont)

- KURT (KAERI Underground Research Tunnel)
 - Validating the safety and feasibility of the suggested disposal system by various in situ experiments.
 - Located at KAERI site.



Tunnel Portal

- Access tunnel is 180 m long with -10% slope and crosssection is horseshoe-shaped with 6m x 6m.
- Two research modules(45 m and 30 m) with +2% slope are located at the end of access tunnel.



Access Tunnel

Research Module

(Quoted from a reference)

Suitability of the ROK for DBD

- Geology of the Korean Peninsula

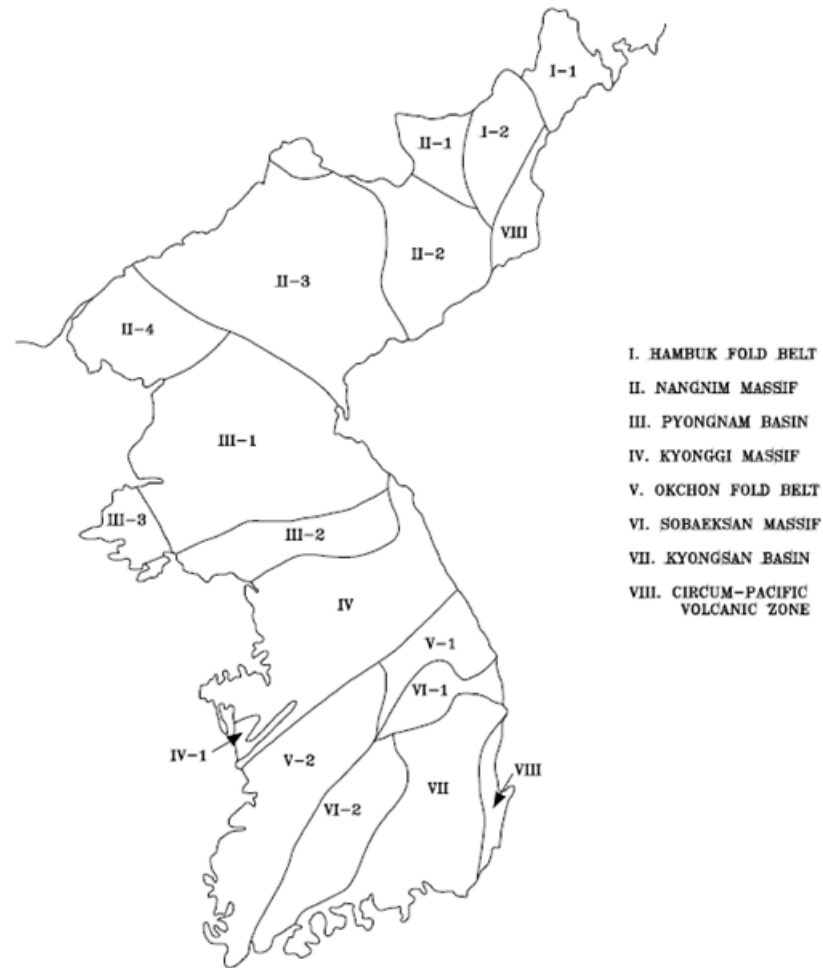


Figure 3: Tectonic Provinces in Korean Peninsula

(Quoted from a reference)

Suitability of the ROK for DBD (cont)

- Population density of the ROK

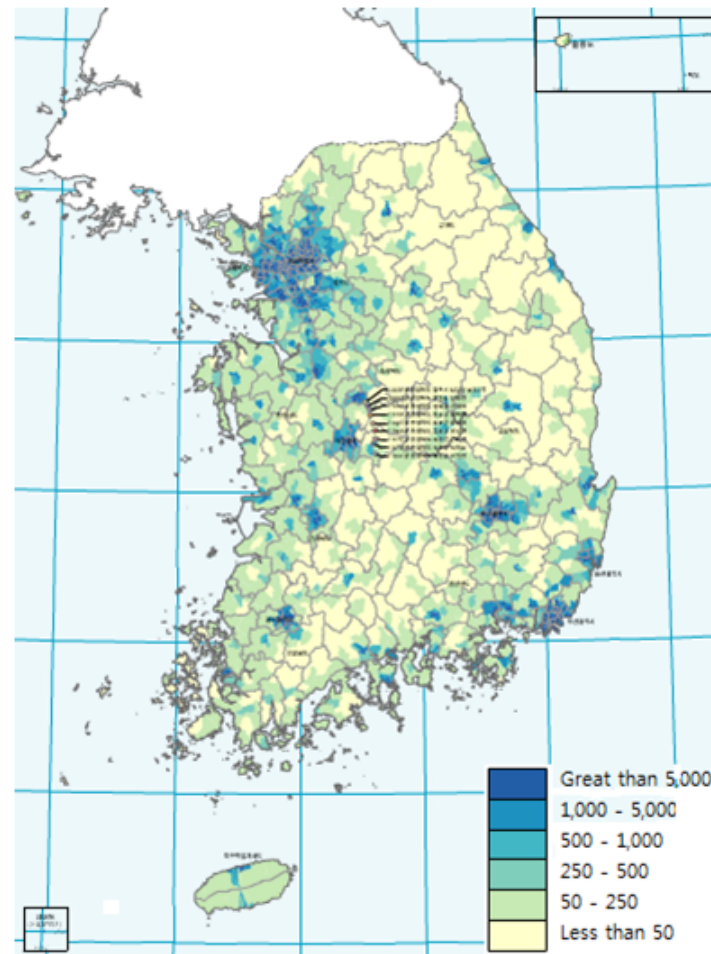


Figure 4: Population Density Map of South Korea in 2005 (Legend: persons per sq. km)

(Quoted from a reference)

Suitability of the ROK for DBD (cont)

- Regional Fractures in the ROK

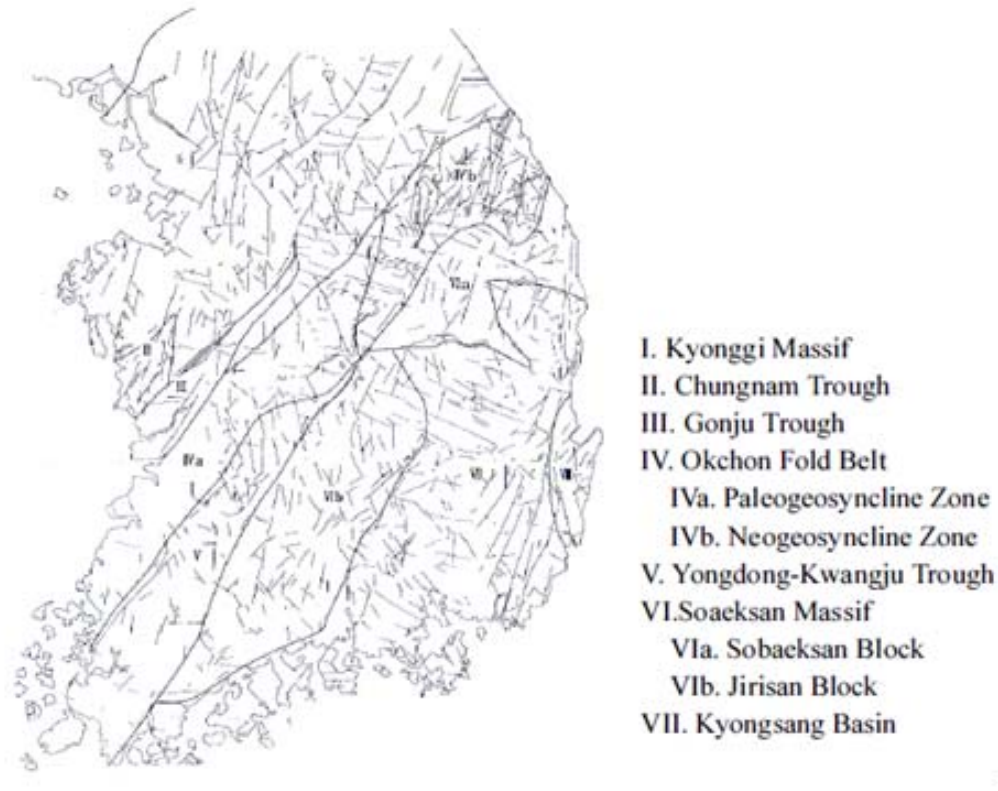


Figure 5: Fracture Map Superimposed on Tectonic Provinces in South Korea⁴¹

(Quoted from a reference)

Suitability of the ROK for DBD (cont)

- Seismicity in the Korean Peninsula

Table 4: Statistics of Magnitude >4.75 Historical Earthquakes on the Korean Peninsula

Century	4.7~ 4.9	5~5.9	6~6.9	≥7	Total
1~10	2	11	1	0	14
11~14	1	13	2	0	16
15	11	13	4	0	28
16	10	30	5	0	45
17	0	14	5	1	20
18	5	8	0	0	13
19	0	0	0	1	1
20	8	15(1)	1(2)	(2)	24(5)
Total	37	104(1)	18(2)	2(2)	161(5)

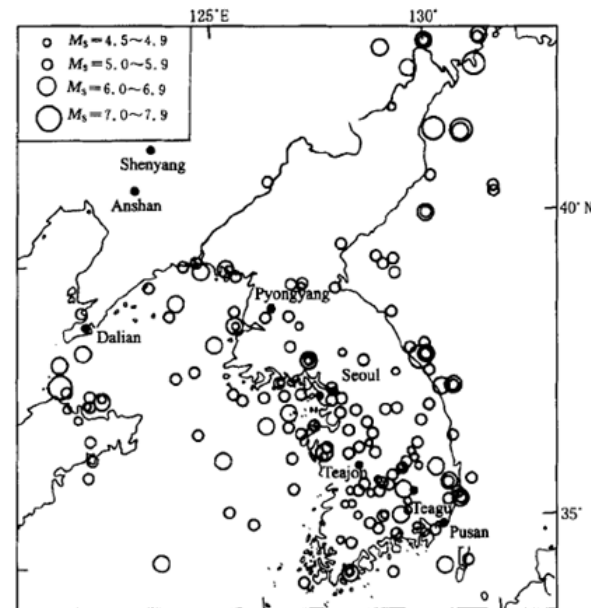


Figure 6: Epicentral Distribution of Historical Earthquakes in the Korean Peninsula

(Quoted from a reference)

Political and Legal Issues

- Whether or not local communities in the ROK would oppose to site for deep borehole disposal of spent fuel/HLW remains to be seen.
- There are no current legal issues that might affect the practicality of borehole disposal of spent fuel in the ROK, since the current Atomic Energy Act does not includes any articles relevant to spent fuel disposal.

Concluding Remarks

- Since spent fuels would be buried at a depth of deeper than 3 km underground, surrounding geologic conditions at any places in the Korean peninsula might be suitable for deep borehole disposal.
- Although South Korea has no national plan on geologic disposal of spent fuel, a set of in-situ tests and experimental works for geologic disposal safety and possibly deep borehole disposal could be done at KURT.