

Spent Fuel Management in Korea



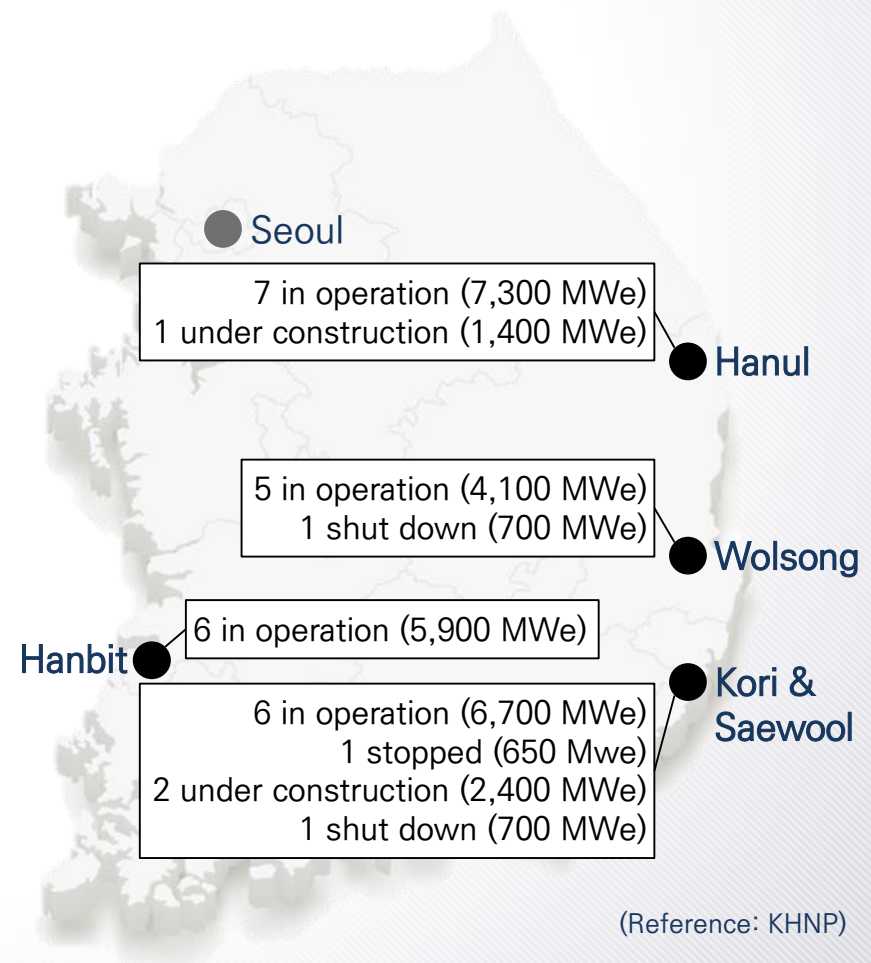
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Nuclear Power Generation

➤ Nuclear Energy in Korea (2024)

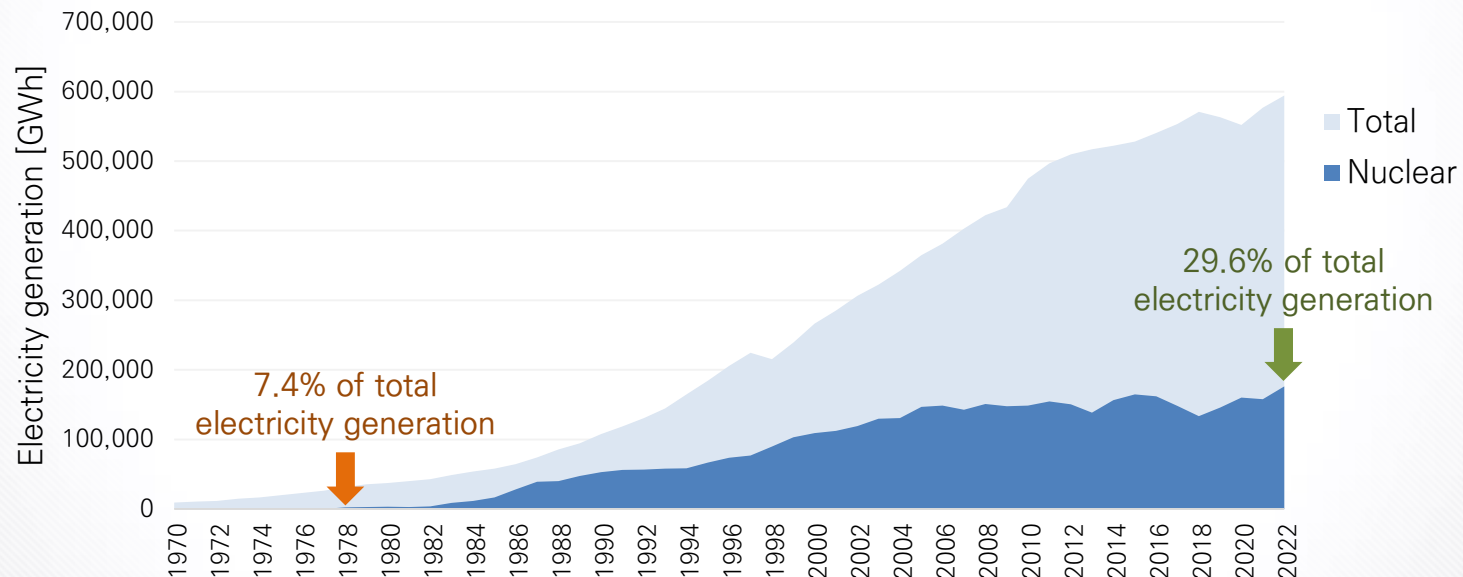
- 25 NPPs (nuclear power plants) with 22 PWRs and 3 PHWRs (24,650 MWe)
 - In operation: 24 NPPs
 - Stop operation: 1 NPP (Kori#2, 2023.04)
- Shut-down of 2 NPPs
 - Kori#1 (2017.06) and Wolsong#1 (2019.12)
- Under construction of 3 NPPs
 - Shin-Hanul#2 and Shin-Kori#5,6



Nuclear Power Generation

➤ Nuclear Energy in Korea

- Electricity generation from nuclear power (2022)
 - Providing 30% (176,054 GWh) of total electricity (594,400 GWh)



- Efficiency, safety, economics of nuclear power (2023)
 - Utilization factor = 81.8% / Availability factor = 82.1%
 - Emergency shutdown rate = 1/25 (0.04)

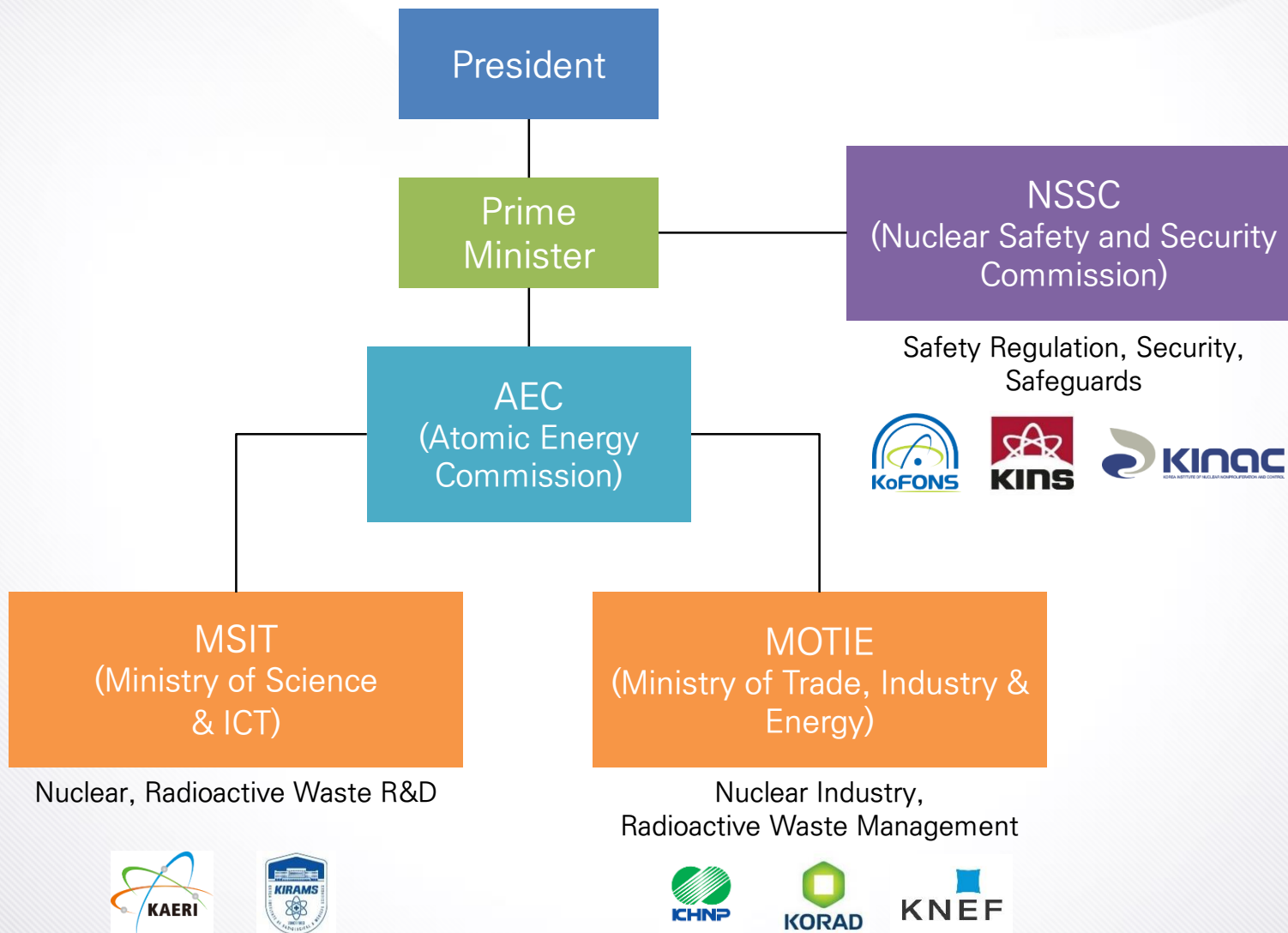
Spent Fuel Storage

➤ Current status of spent fuel storage (2024.01)

- Total 531,414 assemblies (19,353 ton) of spent fuel are generated
 - PWR SFs are stored in AR wet storage facilities
 - PHWR SFs are stored in AR wet and dry storage facilities.

Site		Capacity [assembly (ton)]	Current storage [assembly (ton)]	Saturation Rate [%]
PWR	Kori	8,038 (3,456)	7,163 (3,080)	89.1
	Saewool	1,560 (671)	596 (256)	38.2
	Hanbit	9,017 (3,877)	7,093 (3,050)	78.7
	Hanul	8,669 (3,728)	6,876 (2,957)	79.3
	Shin-Wolsong	2,588 (1,113)	794 (341)	30.7
	Sum	29,872 (12,845)	22,522 (9,684)	–
CANDU	Wolsong	648,352 (12,319)	508,892 (9,669)	78.5

Government Organizations



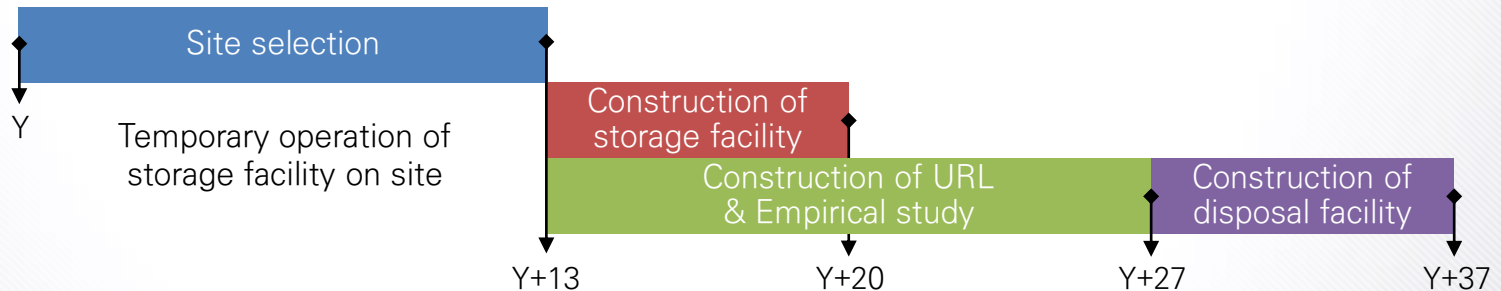
Past SF Management Policy

- 9 attempts to select a radioactive waste disposal site ~ failed (1986~2004)
- Radioactive Waste Management Act (2009)
- Public engagement commission on SF management (2013~2015)
- MOTIE, “(1st) basic plan on HLW management” (2016)
 - Step by step roadmap for securing site, interim storage facility and disposal facility
- MOTIE, “Energy transition roadmap” (2017)
 - Phase-out of nuclear energy and coal energy, expansion of renewable energy and LNG
- MOTIE, “8th basic plan for long-term electricity supply and demand” (2017)
 - Early shutdown of 1 NPP (Wolsung#1, 0.68 GW), construction of 5 NPPs (7 GW), cancellation of 6 planned NPPs, shutdown of 10 NPPs (8.5 GW) by 2030
- MOTIE, “9th basic plan for long-term electricity supply and demand” (2020)
 - Following 8th basic plan, shutdown of one more NPP (1 GW) by 2034

Current SF Management Policy

➤ MOTIE, “2nd basic plan on HLW management” (2021.12)

- Establishment of 2nd basic plan through public engagement
 - Operation of the “Review committee” for the 1st basic plan (2019.5~2021.4)
 - Collection of opinions on the 2nd basic plan, and finalization (2021.7~2021.12)
- Establishment of a revised roadmap for implementing the HLW management policy
 - Selection of a site for management facilities based on social consensus
 - Establishment of a roadmap for the construction and operation of management facilities

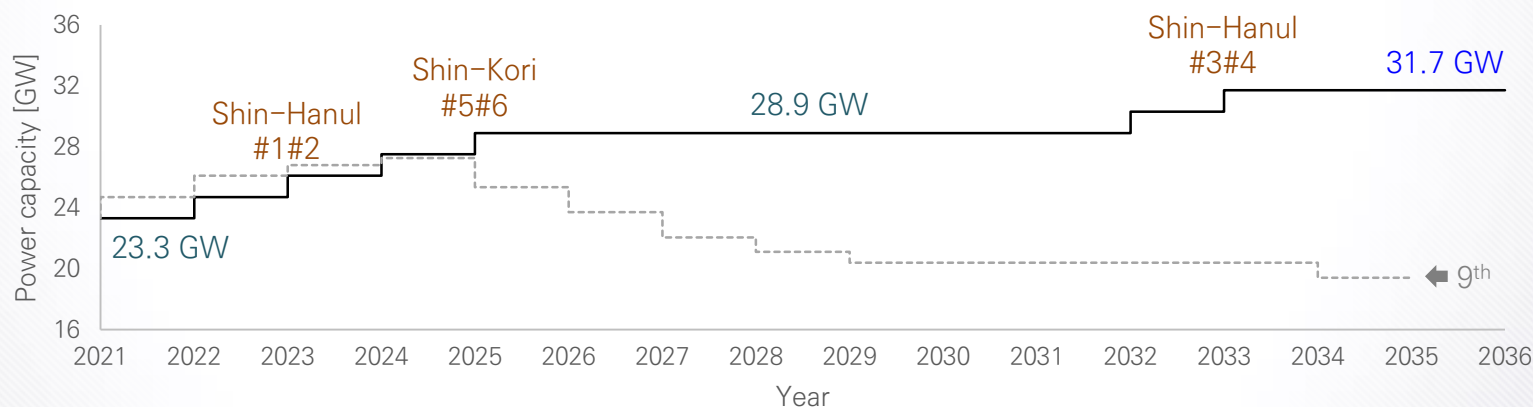


- Temporal operation of AR storage facility
- Development of technologies* required for the HLW management
 - * Transport/storage, site selection, safe disposal

Current SF Management Policy

➤ MOTIE, “10th basic plan for long-term electricity supply and demand” (2023.01)

- Construction of new NPPs and continued operation of existing NPPs
 - Construction of Shin-Hanul#1#2 (2.8 GW), Shin-Kori#5#6 (2.8 GW)
 - Resumption of canceled construction of Shin-Hanul#3#4 (2.8 GW)
 - Continued operation of 12 NPPs (to be stopped before 2036)



- Proportion of nuclear power generation: increase to 32.4% (201.7 TWh) in 2030

Current SF Management Policy

➤ KHNP, Actions for continued operation for 10 NPPs (2022~2024)

- Expanding the organization and manpower for continued operation
 - Establishment of a facility improvement center at KHNP's headquarters (2022)
 - Establishment of a laboratory for continued operation at KHNP's CRI (2023)
- Submission of PSR (Periodic Safety Review) for continued operation to NSSC

NPP	Life expiration	PSR submission	Restart target
Kori #2 (650MW)	2023.4.8	2022.4.4	2025.6
Kori #3 (950MW)	2024.9.28	2022.9.26	2026.6
Kori #4 (950MW)	2025.8.6		
Hanbit #1 (950MW)	2025.12.22	2023.6.30	2027.6
Hanbit #2 (950MW)	2026.9.11		
Hanul #1 (950MW)	2027.12.22	2023.10.30	2027.12
Hanul #2 (950MW)	2028.12.28		2028.12
Wolsung #2 (700MW)	2026.11.1	2024.3.31	-
Wolsung #3 (700MW)	2027.12.29		
Wolsung #4 (700MW)	2029.2.7		

Current SF Management Policy

➤ KRS, Estimation of spent fuel generation and saturation time (2023.02)

- Based on “10th basic plan for long-term electricity supply and demand”
- Total 793,955 assemblies (44,700 ton) of spent fuel will be generated
 - 72,035 assemblies (31,000 ton) for PWR SF / 721,920 assemblies (13,700 ton) for PHWR SF
- Saturation of storage facilities at Hanbit, Hanul and Kori from 2030

		Kori	Hanbit	Hanul	Saewool	Shin-Wolsong	Wolsung	Total
9 th	SF generated [assembly]	10,253	10,660	18,740	15,260	3,565	576,851	635,329
	Saturation [year]	2031	2031	2032	2066	2044		
10 th	SF generated [assembly]	12,290 (2,037 ↑)	13,051 (2,391 ↑)	27,401 (8,661 ↑)	15,660 (400 ↑)	3,633 (68 ↑)	721,920 (145,069 ↑)	793,955 (158,626 ↑)
	Saturation [year]	2032	2030	2031	2066	2042	2037	

Current SF Management Policy

➤ KHNP, Actions for capacity expansion of AR temporal storage

- Plans for the construction of dry storage facilities for PWR SFs in Kori (2023.2), and for PWR SFs in Hanbit and Hanul (2023.4)
 - For stable and continuous NPP operation, and decommissioning of Kori #1
 - Taking out SFs without delay when the interim storage facility is secured
- Start of dry storage facility design for Kori (2023.10)
 - Concept & Detail design (~2025) > License (~2027) > Construction (~2030) > Operation (2031~)
 - Site area: 33,000 m² (expandable to 46,000 m²)
 - Capacity: ≥ 2880 assemblies

Current SF Management Policy

➤ National assembly's efforts

- Proposed three bills to establish legal and institutional infrastructure for systematic and consistent implementation of long-term HLW management policy
 - ① The Minjoo Party (24 members), “Special act on HLW management” (2021.09)
 - ② People Power Party (11 members), “Special act on HLW management facility, etc” (2022.08)
 - ③ People Power Party (21 members), “Special act on HLW management and support for site region” (2022.08)

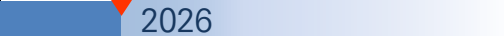
		①	②	③
Common part		Specific procedures for selecting site and securing management facilities Consent-based procedure for site selection Resident vote before the site selection Specific management plan for selected site region		
Different part	Committee	– Central administrative	– Central administrative	– Central administrative
	Establishment of Basic plan	– Self establishment	– Review of Atomic Energy Commission	– Self establishment
	Schedule		– Specific timing	
	On-site storage capacity	– Designed period	– Operation period	– Operation period
	Operator	– KORAD	– Presidential decree	– KORAD

* KORAD: Korea Radioactive Waste Agency

R&D for SF Storage and Disposal

➤ AEC, “HLW R&D roadmap” (2024.02)

- A R&D plan for implementing the 2nd basic plan on HLW management
- Deriving 130 element technologies (473 detailed technologies) as core technologies
 - 22 secured, 74 under development, 33 requiring development

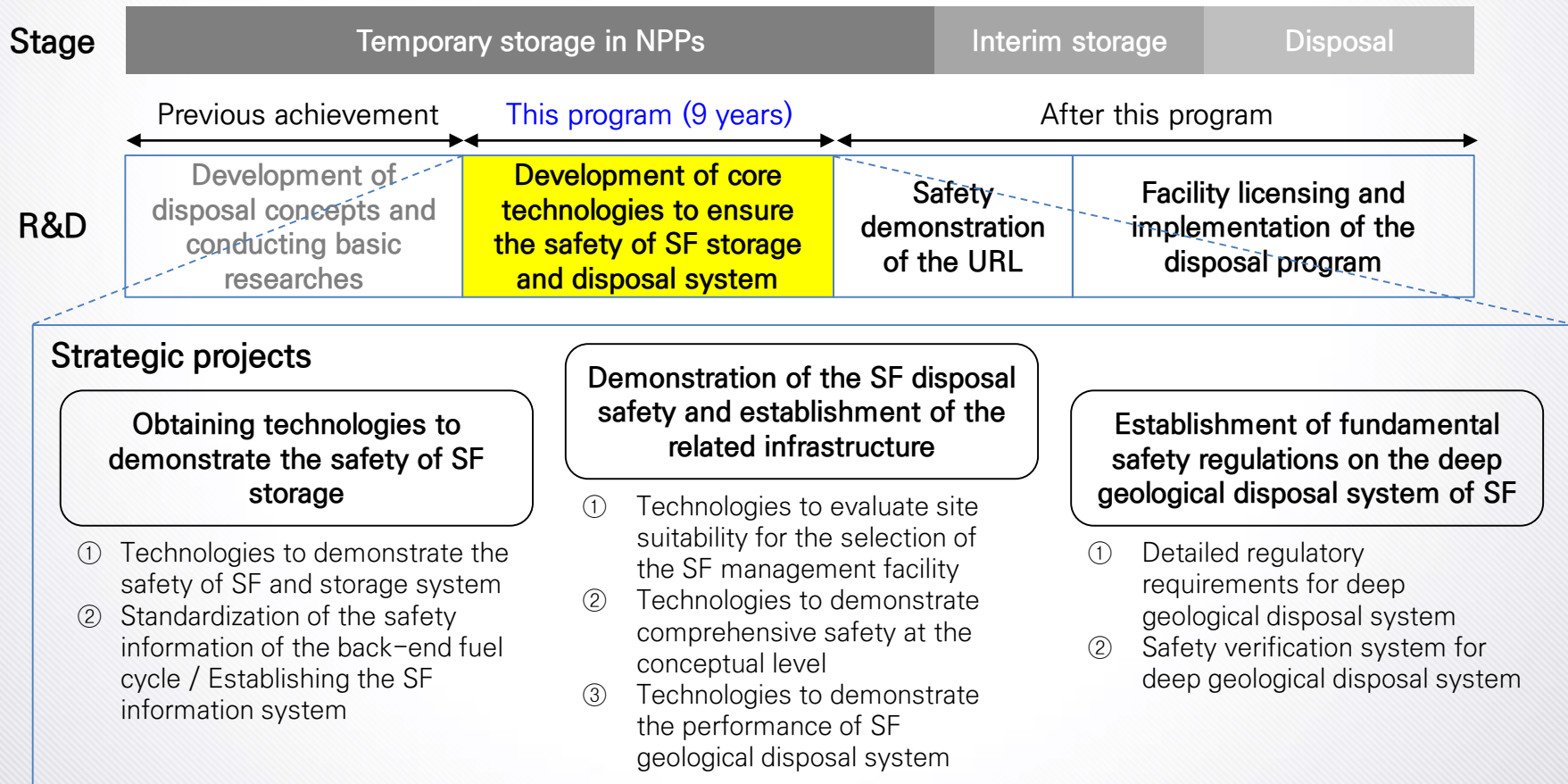
2 nd basic plan schedule		Site selection (Y+13)	Securing interim storage facility (Y+20)	Securing disposal facility (Y+37)
Field	Core technologies (detailed technologies)	Schedule for securing technologies		
Transportation & Storage	30 (108)	 2030s		
Site selection	28 (87)	 2029		
Disposal	46 (141)	 2050s		
Volume & toxicity reduction	26 (137)	Review  2026		

- Budget: approximately 1.25B\$
 - Including 840M\$ for R&D, 380M\$ for infrastructure

R&D for SF Storage and Disposal

➤ iKSNF, R&D program for SF storage and disposal (2021~2029)

- Budget: about 329M\$ (MSIT 163M\$, MOTIE 129M\$, NSSC 33M\$, private sectors 4M\$)

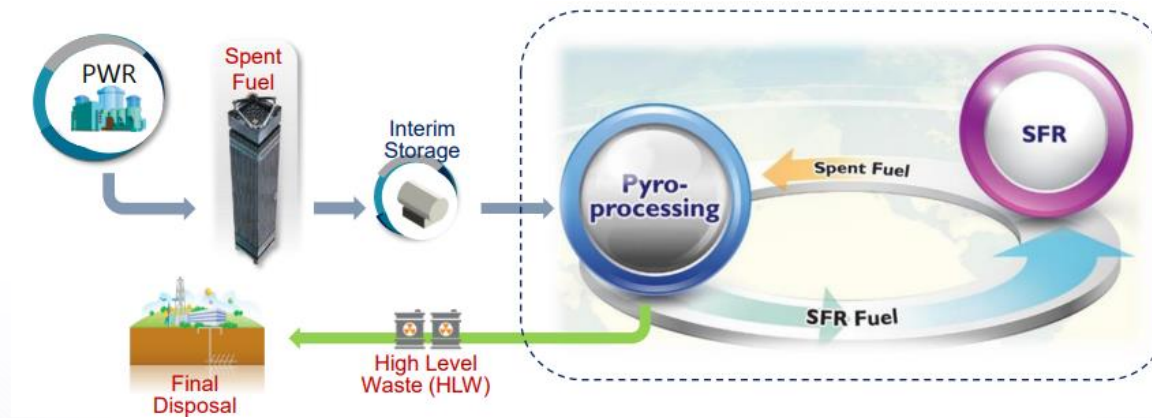


* iKSNF: Institute for Korea Spent Nuclear Fuel

R&D for SF Recycling

➤ MSIT, R&D for pyro and SFR technologies

- Reduction of the burden of HLW management for future generations
 - Pyro: a technology that separates and recovers various elements from SF in a high-temperature molten salt by electrochemical method.
 - Purpose: Reduction of the radiotoxicity, volume, and disposal area of HLW by recycling fuel elements recovered by pyro, in connection with SFR.



▪ ROK-US joint studies (2011~)

- Verification of technical feasibility, economic viability and non-proliferation acceptability of pyro technology including demonstration of kg-scale process

❖ For the SF management policy,

- MOTIE, “10th basic plan for long-term electricity supply and demand”
 - Increase of the proportion of nuclear power generation to 30% by 2030
 - Construction of 6 NPPs and continuous operation of 12 NPPs by 2036
- MOTIE, “2nd basic plan on HLW management”
 - Review of 1st basic plan and establishment of 2nd basic plan through public engagement
 - A step by step roadmap for site selection, interim storage and disposal facility
- KHNP’s actions following the 10th basic plan
 - Starting the process of continued operation for 10 NPPs and expansion of AR storage capacity

❖ For the SF management R&D,

- AEC, “R&D roadmap for HLW”
 - Deriving core technologies and R&D roadmap for transport & storage, site selection, disposal, and volume & toxicity reduction