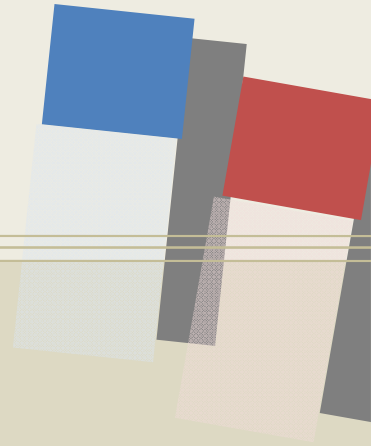


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Status and Perspective of Spent Fuel Management Policy in Korea



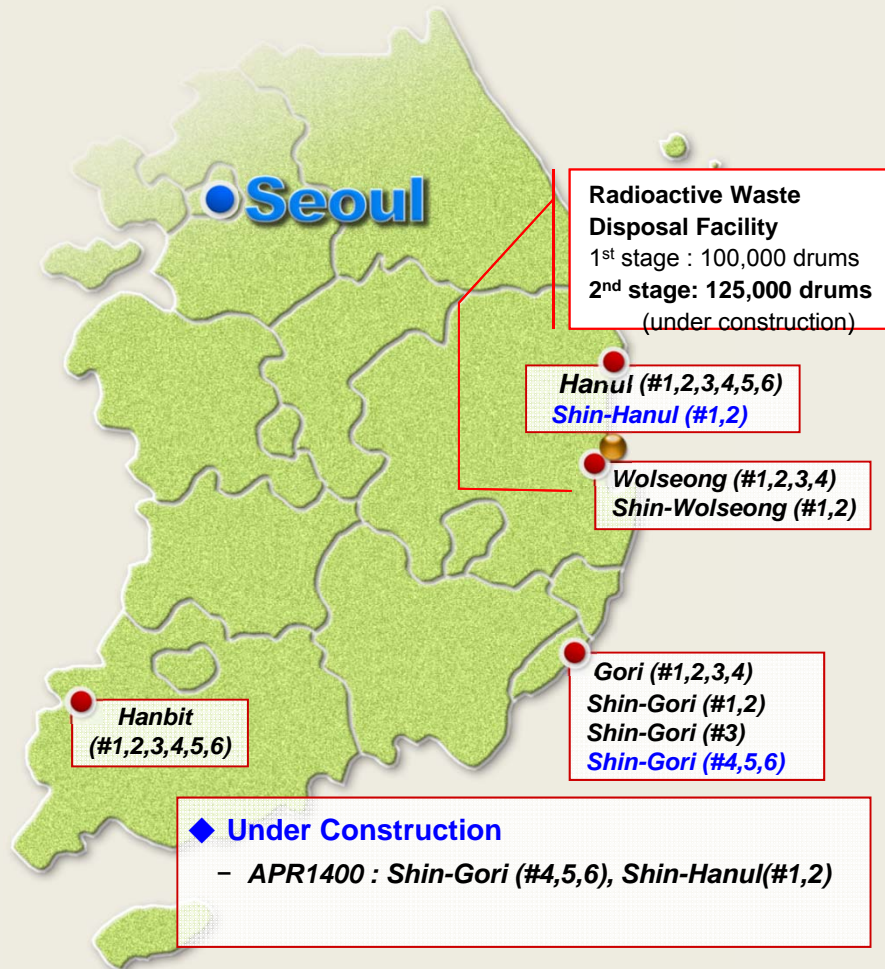


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- ❑ Introduction
 - ❑ on Nuclear energy and Spent fuel management in Korea
- ❑ Previous progresses Spent fuel management
- ❑ Major milestones
- ❑ Basic plan for HLW management
- ❑ More Spent fuel management options considered
- ❑ Investment and implementation plan
- ❑ Conclusion

Nuclear Energy in Korea

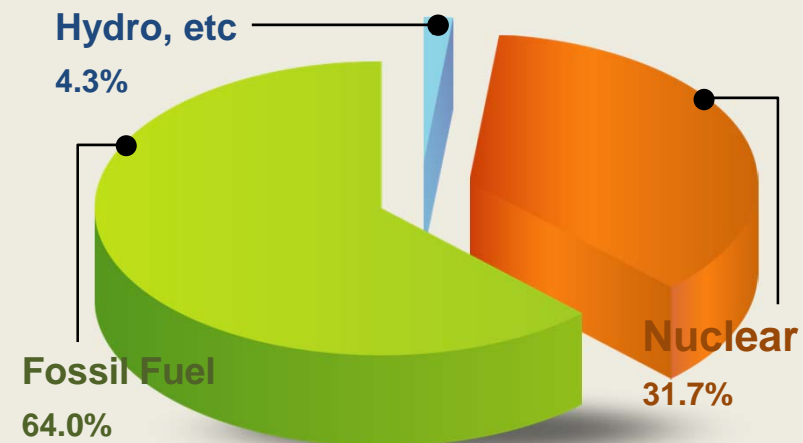
As of April, 2017



Site	In Operation	Under Construction	Total
Gori	7 (6,537)	3 (4,200)	10 (10,737)
Wolseong	6 (4,779)	-	6 (4,779)
Hanbit	6 (5,900)	-	6 (5,900)
Hanul	6 (5,900)	2 (2,800)	8 (8,700)
Total	25 (23,116)	5 (7,000)	29 (30,116)

Source : www.khnp.co.kr

Ratio of Electricity Generation(2016)



Source : www.epsis.kpx.or.kr

Spent Nuclear Fuel Generation

■ Current status of SF storage (As of '15. 12)

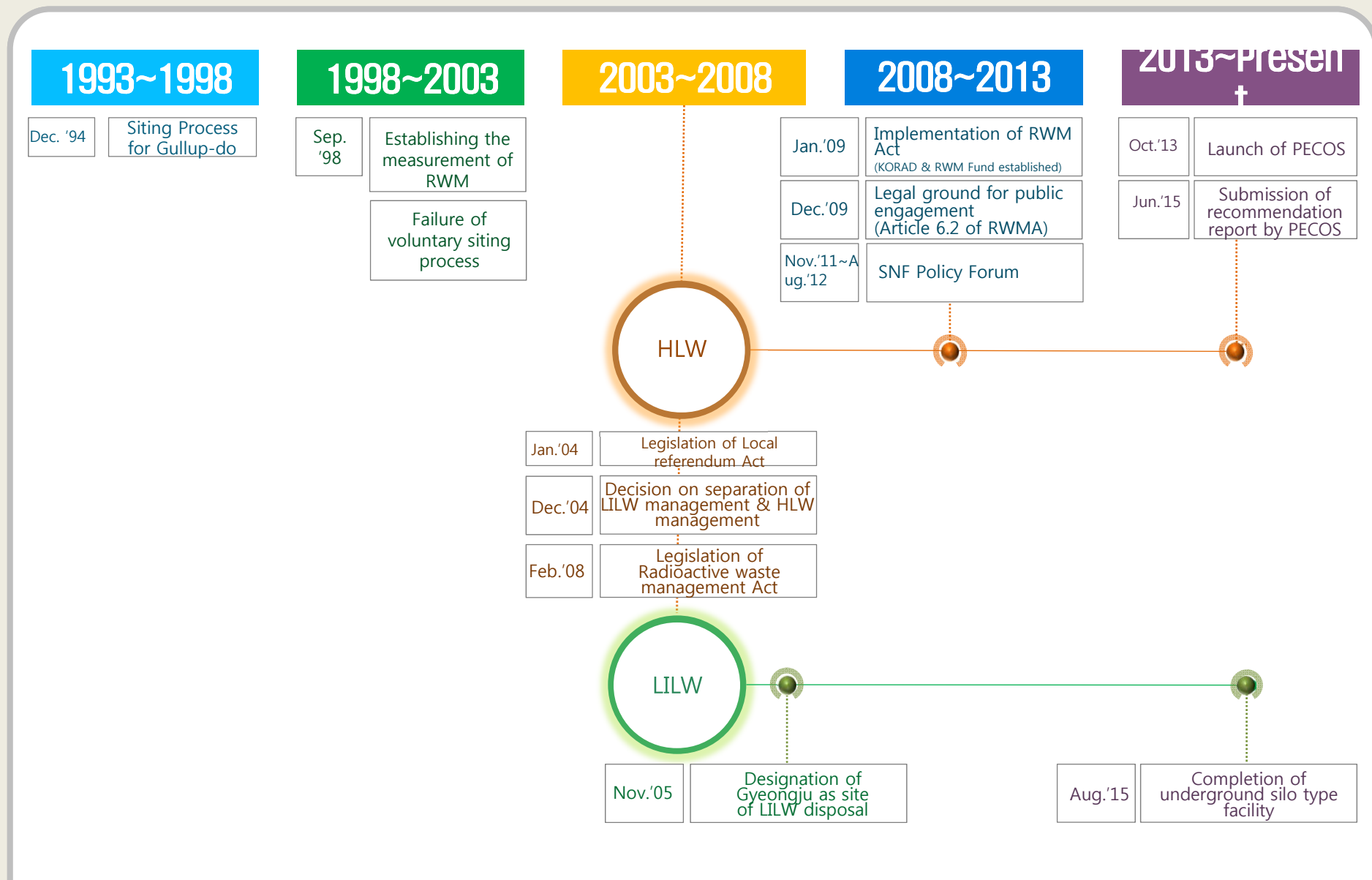
- All PWR spent fuels are stored in the pool of NPP sites
- Some part of CANDU spent fuels are stored in AR dry storage
- On-site SF storage limit will be reached by the mid of 2020s

(As of the end of 2015)

Sites		Capacity	Current storage	Saturation Rate	Expected saturation
PWR	Hanbit	9,017	5,693	63.1%	2024년
	Gori	6,494	5,612	86.4%	2024년
	Hanu	7,066	4,855	68.7%	2037년
	Sin-Wolseong	1,046	129	12.3%	2038년
	Sum	23,623	16,289	68.9%	-
CANDU	Wolseong	499,632	408,797	81.8%	2019년

(about 15,000 tHM)

Progress in radioactive waste management policy in Korea

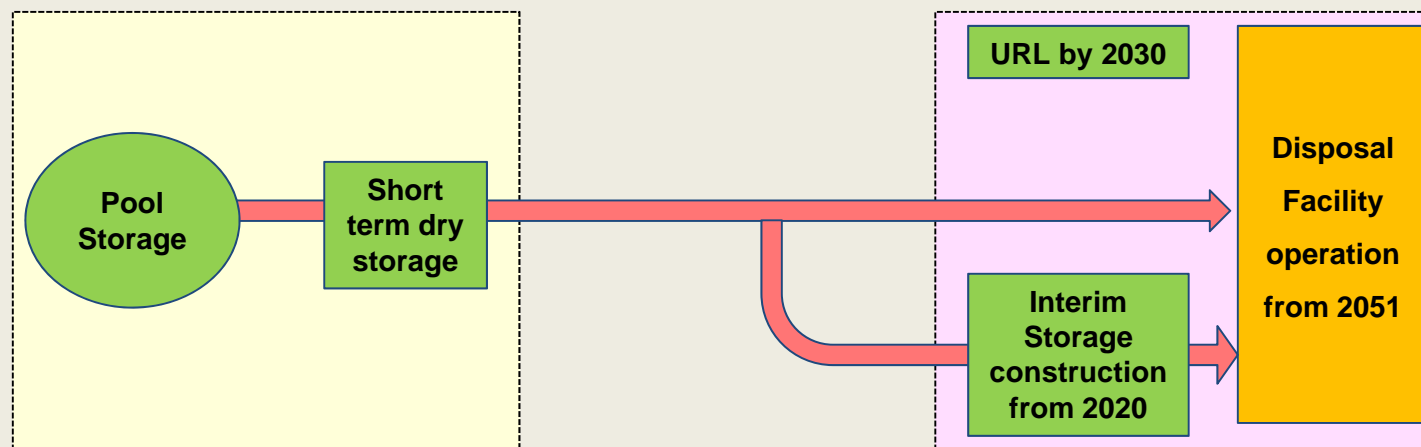


Decisions Regarding Spent Fuel Management

- 253rd Meeting of the KAEC (2004)
 - Storage of spent fuels at reactor sites by 2016
 - Future establishment of national policy on spent fuel management based on open discussions and public consensus
- Radioactive Waste Management Law (2008)
 - Establishment of Korea Radioactive-waste Management Corporation of which responsibilities includes spent fuel interim-storage and disposal
 - Establishment of RWM fund
- Recommendation by PECOS(Public Engagement Commission on SNF Management) (2015)
 - Recommendation of basic direction for three areas ; spent fuel management option, direction of support of local communities, law and institution
- Basic Plan on HLW Management by MOTIE (2016)
 - Announcement of basic plan on HLW management based on the PECOS recommendation

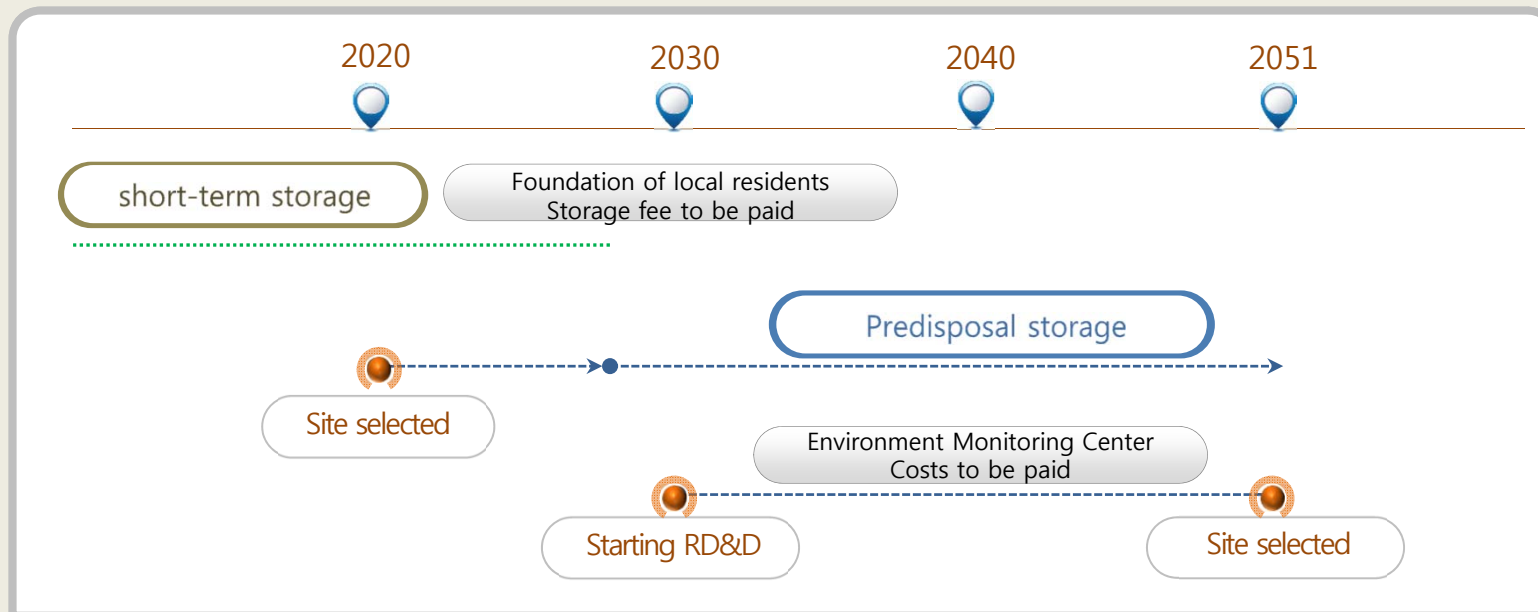
Recommendation by PECOS (2015)

- Suggestion of 10 Recommendations from 20 Months Public Discussion
- Suggestion of Construction Milestone of HLW Management Facilities ; Three Facilities at Same Site
 - URL site acquisition by 2020 and demonstration facility operation from 2030
 - Interim storage at the site before disposal
 - Disposal facility operation from 2051
- Payment of Spent Fuel Storage Fee When AR dry Storage Needed
- Legislation of Spent Fuel Management Law for Assuring Transparency, Safety and Sustainability
- Continuation of R&Ds for Volume and Radio-toxicity Reduction at the Same Time



Main recommendations of PECOS

- ✓ Siting URL(2020)→Start of RD&D on SNF disposal(2030)→Operation of final repository(2051)
- ✓ Constructing predisposal storage within URL site, but on-site short-term storage also considered if necessary
- ✓ Setting up 'Environment Monitoring Center(tentative)' in the siting region of URL & repository, which the related costs will be paid to
- ✓ In case of constructing on-site short-term storage, the storage fee will be paid to the regions and the 'Foundation of local residents(tentative)' will be organized



- ✓ Legislating & amending the related laws, and preparing for the phased plan for R&D and regulatory system
- ✓ Establishing the organization for R&D and management of SNF
- ✓ Organizing the 'Minister's Meeting(tentative)' & 'Task group for SNF management(tentative)

Decisions Regarding Spent Fuel Management

- 255th Meeting of the KAEC (2008), 1st Meeting of the KAEPC (2011) : Long-term R&D Plan and 6th Meeting of the KAEPC (2016) : Long-term R&D Plan on Future Nuclear System
 - Sodium cooled fast reactor (SFR) technology development (~2028)
 - Pyro process technology development (~2025)
- Submission of Legislative bill on the Approach of Site Selection for the HLW Management Facility and Support for the local communities (2017)
 - Committee for the Site Selection for the spent fuel interim storage and final disposal
 - Approach for the Site Selection
 - Committee for the support of the local communities

Summary of the draft national plan for HLW management

Legally based on

- Article 6 of the Radioactive Waste Management Act(RWMA)
- Presenting the principles and directions for radioactive waste management(RWM) as the highest level of plan
- KORAD should establish the implementation plan based on the national plan annually according to the Article 7 of RWMA

Process

- The Atomic Energy Promotion Commission(AEPC) approves the national plan for RWM drafted by MOTIE, according to the Nuclear Energy Promotion Act

Contents

- ①Policy on HLW management ② Current situation & estimate of HLW generation ③Facilities development plan including siting process ④Investment plan ⑤Plan for social trust & confidence ⑥R&D plan

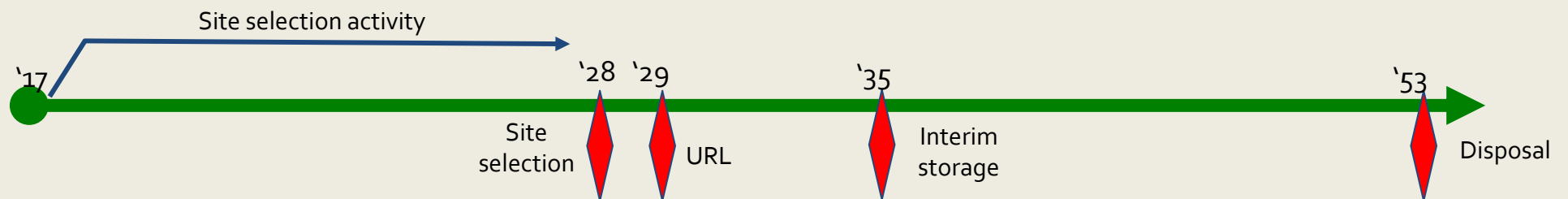
Basic Plan on HLW Management (2016)

- Suggestion of Step by Step Method and Procedure for Site Selection
- Same site for Licensing URL, Interim Storage and Disposal, at the same time, Continuing Effort for the International Storage and Disposal
- Site Acquisition from Scientific Examination and Democratic Procedure
 - Exemption of unsuitable region of all national land
 - Invitation of local governments in suitable regions
 - Basic examination for the site including site characteristics and suitability
 - Confirmation of the public opinion of the region passed the basic examination
 - Detail examination of the site confirmed the public opinion
 - Final decision
- Establishment of the Independent Organization for the Site Selection

Step	Exemption of unsuitable region	Invitation of local governments	Confirmation of the public opinion	Basic Examination	Detail examination of the site
Duration	8 years				4 years

Basic Plan on HLW Management (2016)

- Interim Storage Construction After Site Acquisition (7 years) and Disposal Facility Construction After Site Acquisition (24 years)
- R&Ds on Key technologies
 - Transportation, interim storage and disposal
 - General URL for disposal safety
 - Pyroprocessing for volume and radio-toxicity reduction of spent fuel
- Transparency and Public Acceptance
 - Open information and related data
 - Site selection organization consisting of neutral persons and experts
 - Monitoring organization governed by local government in a HLW management region



Principles of HLW management

1. Governmental responsibility



- As HLW needs to be safely managed for long-term period, HLW should be managed under control of government, conforming to domestic and overseas safety standards.

2. Top priority on safety



- The public health and the environment should be protected by eco/environmental friendly management of HLW.

3. Trust & confidence



- Information should be open to the public.
- HLW management project should be under the public consensus.

4. Due burden on present generation



- Present generation should be responsible for HLW
- 'Polluter Pays' principle should be applied

5. Effectiveness of HLW management



- Technologies on transportation, storage, disposal and reduction of toxicity & volume should be developed for effective management of HLW

Roadmap for HLW Management

1

- Phased siting process for site-specific URL, interim storage & final repository in the same site
- Scientific investigation and democratic decision-making procedure(12 years) needed for siting process
- Interim storage & site-specific URL to be constructed concurrently
- Construction of final repository to be followed by RD&D at the URL
- on-site storage inevitably needed before operation of interim storage



2

- Efforts to be made for multinational repository project in parallel, based on international cooperation



3

- Key technologies to be developed for safe and economical management in timely manner

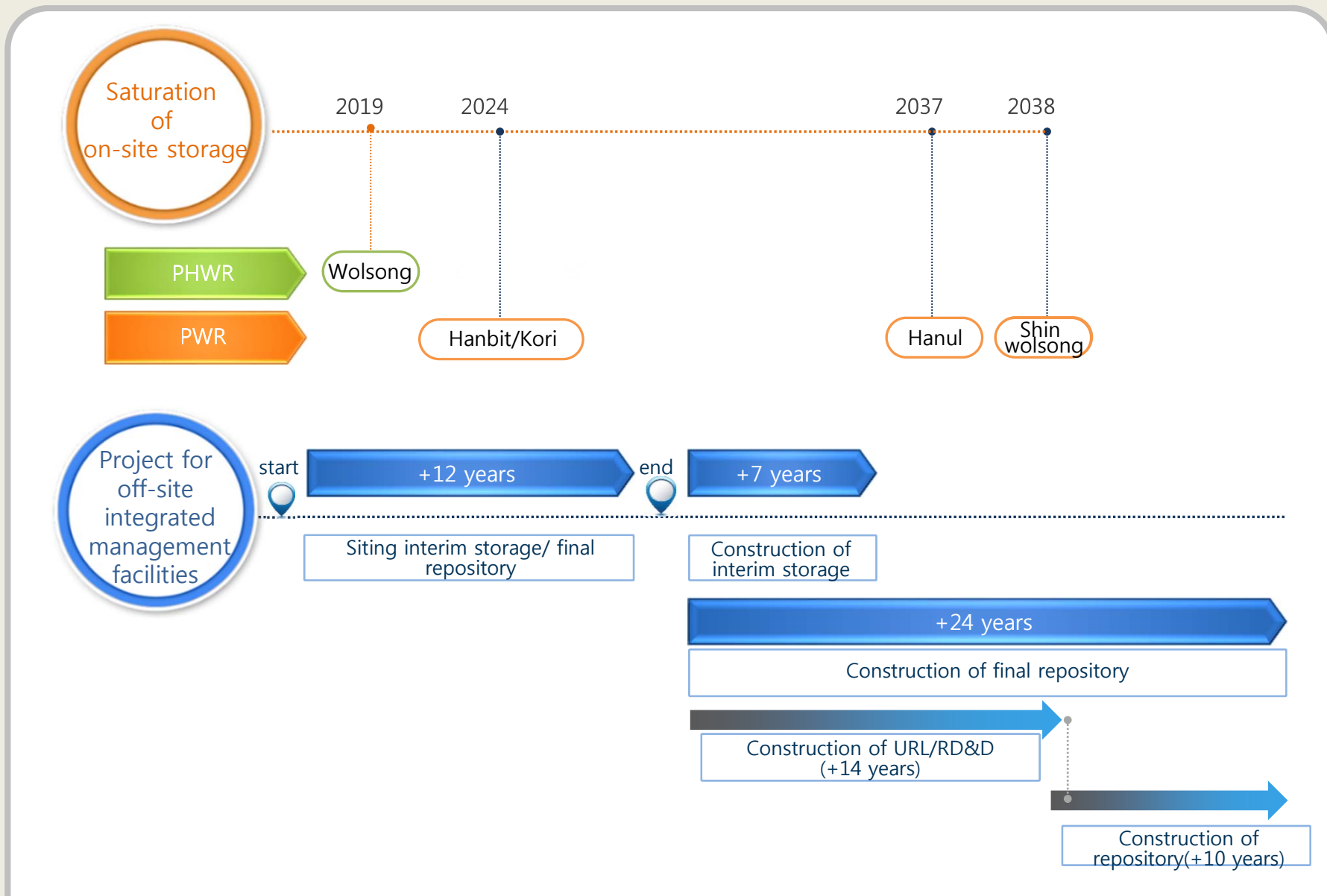


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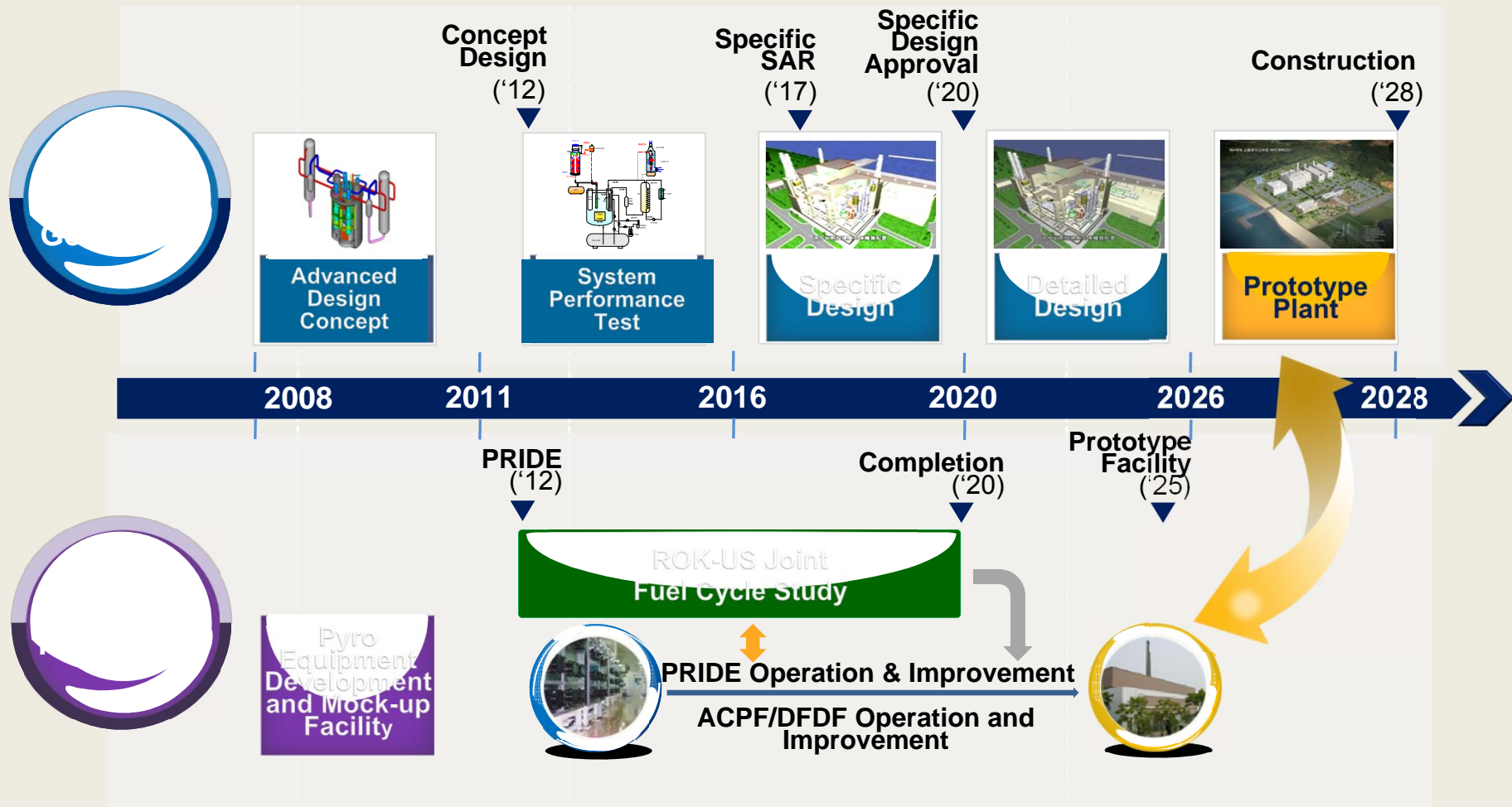
- Information on operation of HLW management facilities to be open
- Communication with local residents to be continued



Milestone of HLW management plan



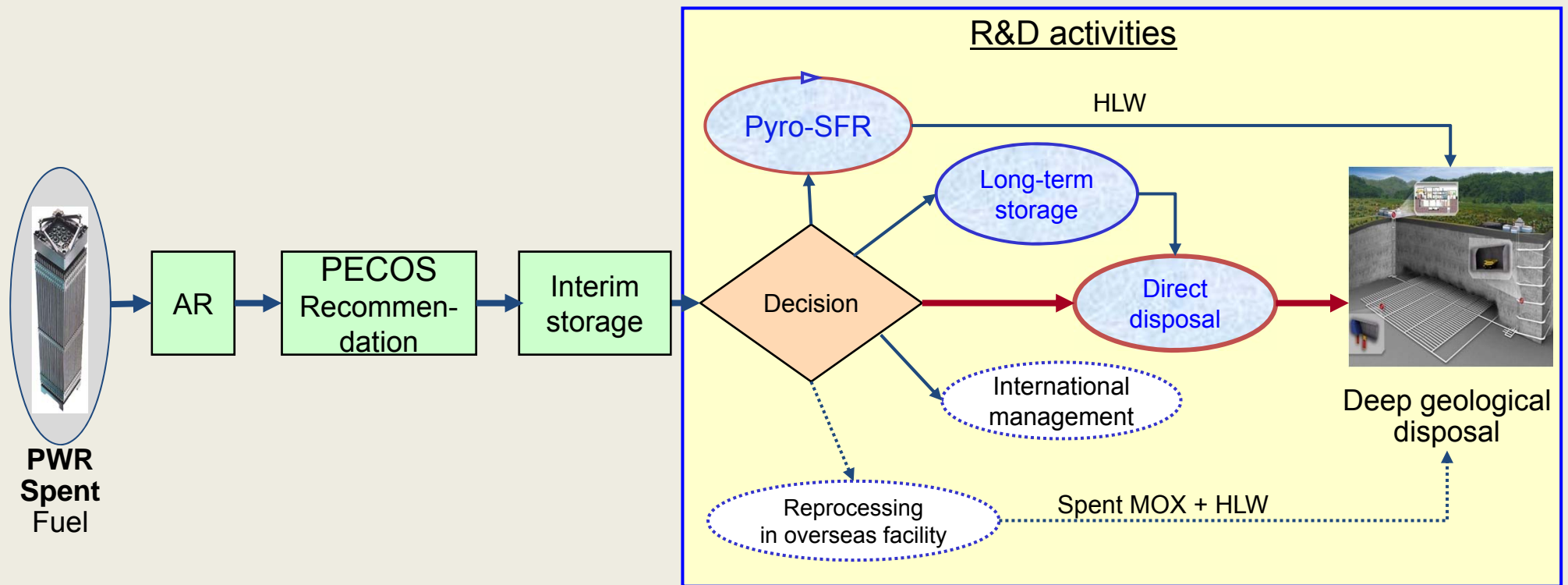
Long-term R&D Plan on Future Nuclear System (2016)



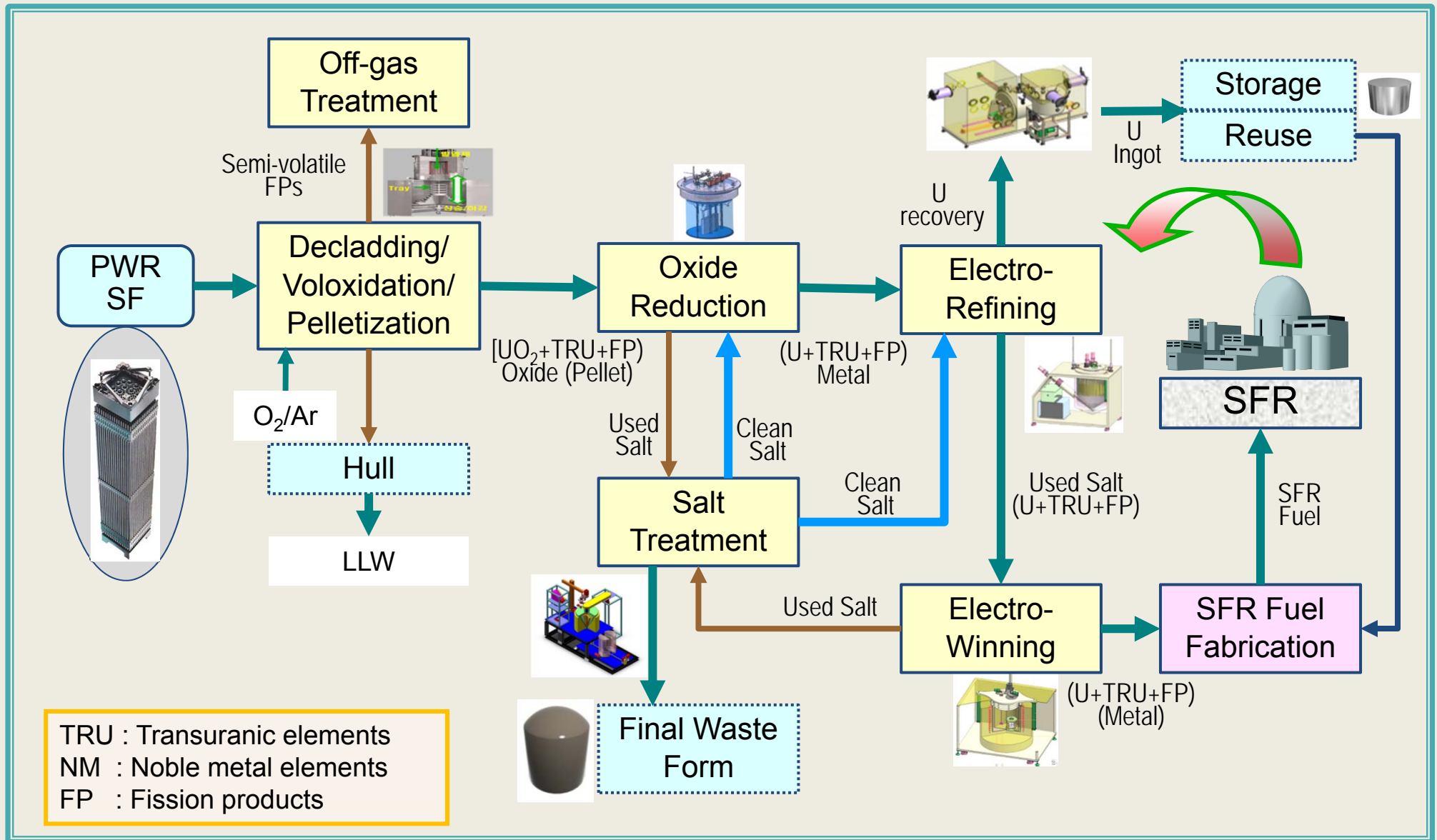
- Facility construction will be determined in 2020 after ROK-US Joint Fuel Cycle Study

Spent Fuel Management Options

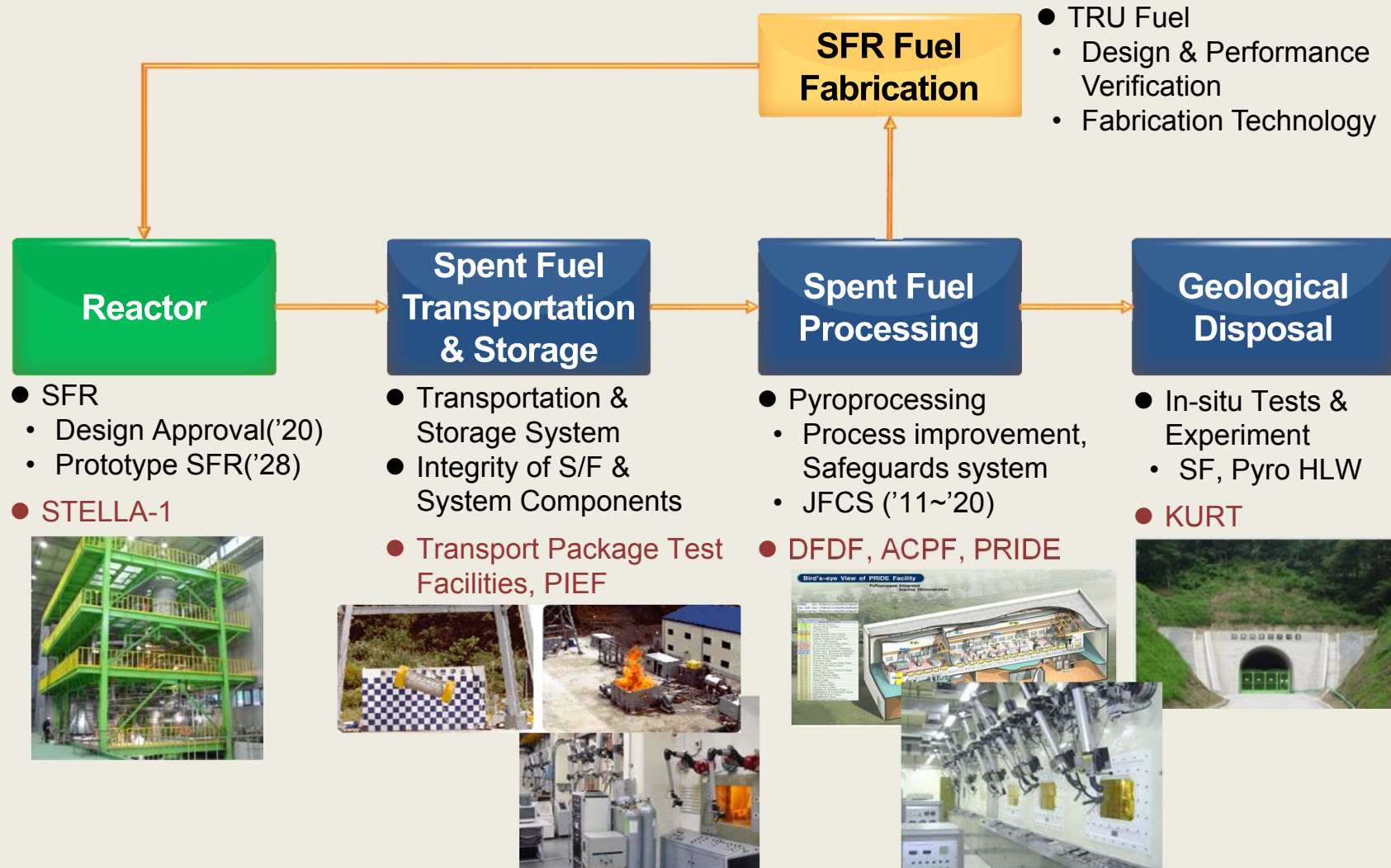
- Final spent fuel management policy will be determined based on further R&Ds
 - Long-term storage of spent fuel and associated wastes
 - Pyroprocessing-SFR Closed fuel cycle
 - Direct disposal



Flow Diagram of Pyroprocessing



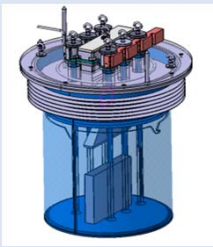
Dry Recycling of SNF



Process Development Objectives and Achievements

- Increased throughput, process efficiency and scale-up
 - Graphite cathode employment to recover U in electrorefining system
 - Application of residual actinides recovery (RAR) system
 - High performance electrolytic reduction process
- Reduced waste volume
 - Crystallization to recover pure salt from waste mixture
- Simple / easy remote operability and enhanced inter-connection between unit processes
 - PRIDE experience

Electrolytic Reduction Equipment (50kg/batch)



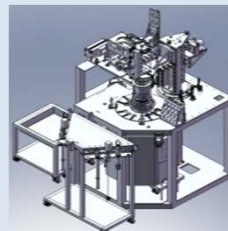
Higher Throughput

Electrorefiner with Graphite Cathode



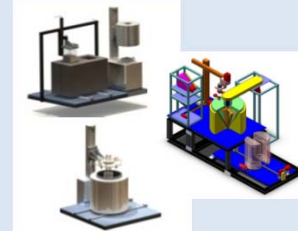
Higher Throughput

RAR Process Using LCC



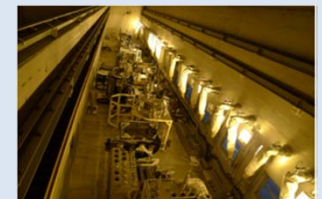
TRU Loss < 0.1 %

Waste Treatment with Layer Crystallization



Waste Volume Reduction (1/25)

PRIDE Facility



Integrated Mockup Facility

Investment Plan

Budget

- Regular reviews on budget for development & operation of facilities and R&D

※ According to the Enforcement of RWMA, overall costs for RWM is calculated every 2 years

- Approval on budget by auditing committees of MOTIE & MSIP

Funding

- Costs for HLW management to be paid by utility annually
- Amount of fund paid by utility to be the same with investment budget
- Unit cost for RWM to be adjusted after biennial review

※ Present unit cost : about \$2.6 billion/assembly, about \$10,000/bundle
(as of about \$4,410 million for investment budget estimated in June 2013)

Implementation Plan

Strategy Committee of HLW Management (tentative)

- Function:
 - Making decision on siting process and principles of incentive program for hosting region for transparency
 - Submitting the result of their activities to Prime Minister & MOTIE
- Composition : Less than 20 people(professors, journalists, lawyers & NGOs, etc), who are independent and neutral

Administrative support

- 'Planning & Implementation Working Group(tentative) to support the siting process
- 'Communication Monitoring Group(tentative)' for transparent release of information
- Close relationship for cooperation among the ministries & related organizations

Conclusion

- Korea has not a definite spent fuel management policy and still so-called 'wait and see'.
- Based on the public engagement activities from 2014 to 2015, major milestones on spent fuel management were established by government (Basic Plan on HLW Management)
 - Site acquisition of URL and repository
 - Interim storage of spent fuels
 - Disposal of HLWs
- R&Ds on spent fuel management options will continue by the end of 2020's
 - Transportation and Long-term storage of spent fuel led by KORAD under MOTIE
 - Pyroprocessing linked to SFR led by KAERI under MSIP



**Thank you
for your attention!**