Topical Meeting under the Joint Convention
Session 7 : Public acceptance

Siting and Public Acceptance of Radioactive Waste Disposal Facilities in Korea

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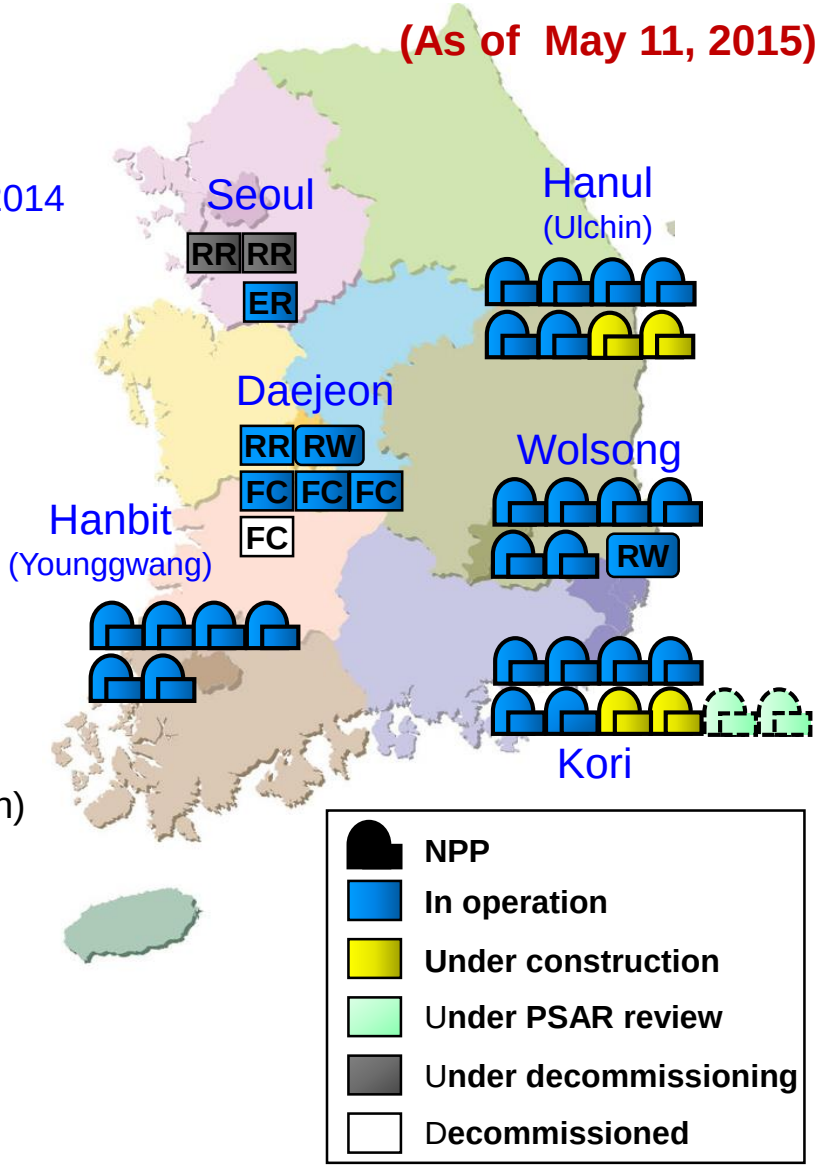
Korean Nuclear History

1957	▪ IAEA membership
1958	▪ Atomic Energy Law
1971	▪ Energy Plan (three reactors with about 600 MW each)
1978	▪ The first unit Kori #1 started to produce electric power
1983	▪ The second and third units (Kori #2, Wolsong #1) started
1980's	▪ 9 reactors in operation ▪ Plan for self-reliance in nuclear power technology
1990's	▪ Korean standard nuclear power plant
2000's	▪ Advanced NPP (APR1400) ▪ Export 4 X 1.4 GW reactors to UAE
2010~	▪ SFR and Pyro development

Nuclear Fuel Cycle Facilities in Korea

- Nuclear Power Plant (NPP)
  - 24 units in operation and 4 units under construction
    → OL for Shin-Wolsong Unit 2 granted in November 2014
  - 2 units under PSAR review for CPs
- Research Rector (RR) / Education Reactor (ER)
  - HANARO (RR)
  - KRR 1 and 2 (RR, under decommissioning)
  - AGN (ER)
- Nuclear Fuel Cycle Facility (FC)
  - Fuel Fabrication Plant for NPP
  - Fuel Fabrication Facility for RR
  - Post-Irradiation Examination Facility (PIEF)
  - Uranium Conversion Facility (released from regulation)
- Radioactive Waste Management Facilities (RW)
  - RI Waste Management Facility
  - Wolsong LILW Disposal Center (WLDC)
    → in operation since 2015



Korean Radioactive Waste Management Policy

Early Korean Policy for Radioactive waste management

- Storage of the waste on site (Since 1978)
- Find disposal site later (Some time after the operation)

Later Korean Government started to work on waste disposal

- Siting work started from mid 1980's

☐ History of LILW disposal project

1986	• Starting of waste disposal siting by KAERI
1989-1990	• 3 areas of East Coast (Ul-jin, Young-duk, Young-il)
1990-1991	• Violent opposition in An-myun island
1994-1995	• Gul-up island selected and cancelled
Jan. 1997	• Transfer of project initiative from KAERI to KEPCO/NETEC
Sep. 1998	• 249th Atomic Energy Commission's policy - Construction of LILW repository by 2008 - Construction of SF interim storage facility by 2016 (same site)
Jan. 2000	• Voluntary site solicitation campaign
Feb. 2003	• Announcement of 4 candidate sites (Ul-jin, Young-duk, Young-kwang, Go-chang)
2004	• Wi Do, Bu-an gun
Dec. 2004	• 253rd Atomic Energy Commission' s change of policy
2005	• New siting system adopted and siting finalized

Government attempted to secure a disposal site

Government Initiative : 1986 ~ 1996

- **1st attempt : 1986 ~ 1989**
  - Three sites identified through literature survey
- **2nd attempt : 1990 ~ 1991**
  - Ahn-myun Island selected for site investigation
- **3rd attempt : 1991 ~ 1993**
  - Six sites identified by a third party (SNU)
- **4th attempt : 1993 ~ 1994**
  - A financial support package suggested
- **5th attempt : 1994 ~ 1995**
  - The Gul-up Island chosen by the Government

Siting responsibility transfer to MOCIE/KHNP (1997)

Solicitation System : 2000 ~ 2004

- **6th attempt : 2000 ~ 2001**
  - Solicitation opened to 46 local governments
- **7th attempt : 2002 ~ 2003**
  - Solicitation to four possible cities around NPP's
- **8th attempt : 2003**
  - Wido at Buan county was a potential candidate
- **9th attempt : 2004.2 ~ 2004.9**
  - A financial support package was offered to 7 cities

10th Attempt : Successful

The First Round of Siting

- Government started to work on radioactive waste management in mid 1980's.
- The first "radioactive waste management policy" established (Oct. 13, 1984)
  * LILW Land disposal, All the cost paid by waste generator, Dedicated organization to be created, Spent fuels to be stored at the LILW disposal site.
- In 1986, KAERI was designated as the project manager, and siting work started.

1. Started of LILW disposal siting (1986 ~ 1989)

- KAERI (Research Organization) selected 3 candidate sites (Ul-chin, Young-duk, Young-il) through literature survey.
- KAERI attempted to conduct site investigation activities.
- Local residents and NGO (Anti-pollution group) expressed strong objection.
- All candidate sites investigation work were cancelled in 1989.

Anti-pollution movement group and Young-duk citizens

No Nuclear !!
Nuclear means
- Contamination and Destruction to our descendants

2. Nuclear complex approach (1990 ~ 1991)

- KAERI made site investigation study at Ahn-myun Island for their second research facilities without notification to the local residents.
- In fact, the site was to accommodate the research facilities and radwaste facilities.
- Local residents and NGO (Anti-pollution group) felt that they were deceived.
- Nuclear power banishment group organized and Anti-nuclear campaign started.
- The second research center plan was cancelled in 1991.

The First Round of Siting

3. Uninhabited island (1994 ~ 1995) – Strong Initiative by the Government

- Gul-up Island (an uninhabited island, 55 miles away from the main land) was selected as candidate site by Government after preliminary site investigations.
- Official announcement as the waste disposal site and local community support program was also established. **(Decide, Announce and Defend)**
- Public debates were open, but not much effort to listen to stakeholders.
- Near-by community residents and NGO (Anti-pollution group) gathered, and questioned the possibility of active faults near the site.
- Later near-by active fault was identified through the detailed investigations.
- The site was cancelled in Dec. 1995.

Notes

- No transparency in the decision making process.
- NGO start to get involved in politics.

The Second Round of Siting

Change of the Project management from KAERI, research organization to KEPCO/KHNP, NPP operator **(1997)**

Radioactive Waste Management Fundamental Principles established (Sep. 1998)
- Direct control by the government
- Top priority on safety
- Minimization of waste generation
- "Polluters pay" principle
- Transparency of site selection process

4. The attempt under new policy and open solicitation system (2003 ~ 2004)
- Site selection committee was organized for open solicitation.
- Bu-Ahn city mayor with strong leadership made proposal to Government upon official solicitation after preliminary site investigations.
- However, he failed to have the authorization later from the local congress.
- NGO's and Anti-nuclear groups led large scale and strong demonstrations.
- Private inhabitant's poll which is illegal was conducted by the NGO.
- The government nullified the whole program.

Notes
- The local Governor's strong leadership.
- NGO gets stronger in their power exercise.
- Religious bodies (more powerful) started to get involved in nuclear issues.

The Second Round of Siting

Bu-Ahn City

Temporary Storage Status at NPP Site

(Waste in 200-liter drum at the end of 2005)

NPP site	Number of reactors	Storage capacity	In-storage	Full storage
Kori	4	50,200	34,099	2014
Hanbit	6	23,300	14,325	2012
Hanul	4	17,400	13,136	2008
Wolsong	4	9,000	5,328	2009
Sum		99,900	59,940	
RI waste (KAERI site)		9,277	4,712	2010

* The storage capacity is becoming full

Review of the Past Attempts

① Long-term safety concern specially for spent nuclear fuels

- ✓ Doubt on the safety of the centralized AFR storage for spent fuel
- ✓ Worried about the storage site becomes the final repository

② Lack of transparent process and stakeholders involvement

- ✓ Lack of transparency in the siting processes
- ✓ Some of the stakeholders were excluded, and those became active members of the opposition group

③ Distrust to the government and nuclear industries

- ✓ Build-up of distrust due to the frequently change of government policies
- ✓ Very little confidence to nuclear industries

④ Incentive package

- ✓ The incentive packages to the hosting city were not acceptable by the residents
- ✓ The residents wanted to be individually compensated

⑤ Ineffective response to the anti-nuclear groups and the use of violence

Change of the Strategy (2005)

Safety aspect

- ✓ The site will host only a LILW repository **(excluding AFR storage for SF)**
- ✓ Technical site condition is to be checked before the siting process

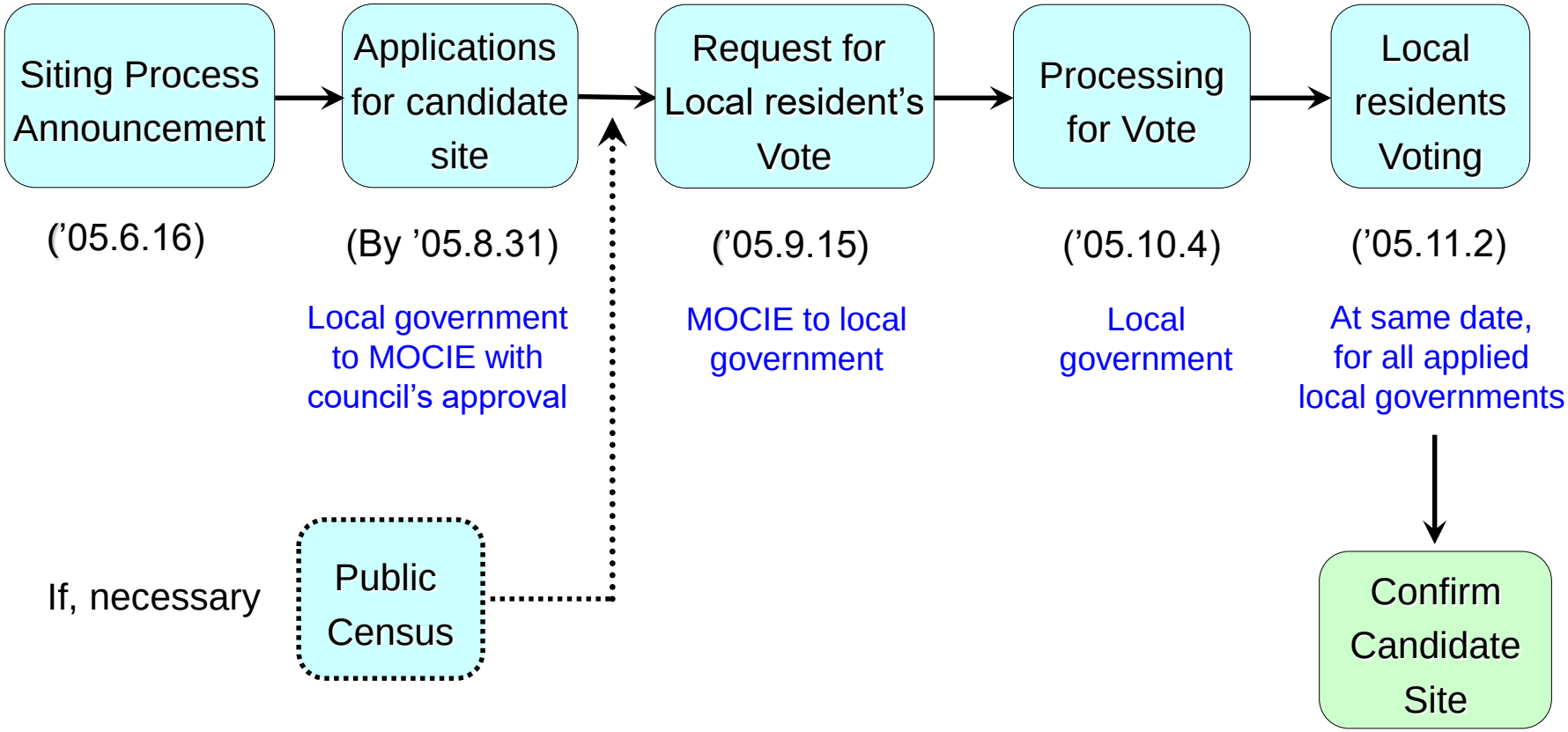
Process transparency and stakeholders involvement

- ✓ Site selection committee will have NGO representatives
- ✓ In-advance issuance of a site selection guidelines
- ✓ Application by the local governor after local council's approval, and local referendum

Incentives to hosting community as per the special law

- ✓ Enactment of a special law that legally binds various incentives
  - lump-sum financial support of US $ 300M
  - annual financial support during operational period
  - move of the KHNP head office and the proton accelerator facility

New Site Selection Process



Successful Siting Selection Attempt

5. The final attempt under new system (2005)

- The government established a new transparent process.
- Special Law was promulgated.
- The law included new siting process requiring inhabitants' poll, stakeholder involvement prior to proposal, and specified an incentive package.
- Site Selection Committee (member of 17 including 9 NGO's) established.
- Four cities made proposals (harsh competition).
- Inhabitants' polls were conducted at the four cities at the same time.
- Gyeong-Ju city showed the highest supporting rates (89.5%).
- Gyeong-Ju city was selected as the disposal site hosting city (Nov. 2005).

Overview of Wolsong LILW Disposal Facility

☐ Area

- Approximately 2,100,000 m²

☐ Disposal Capacity: 800,000 drums

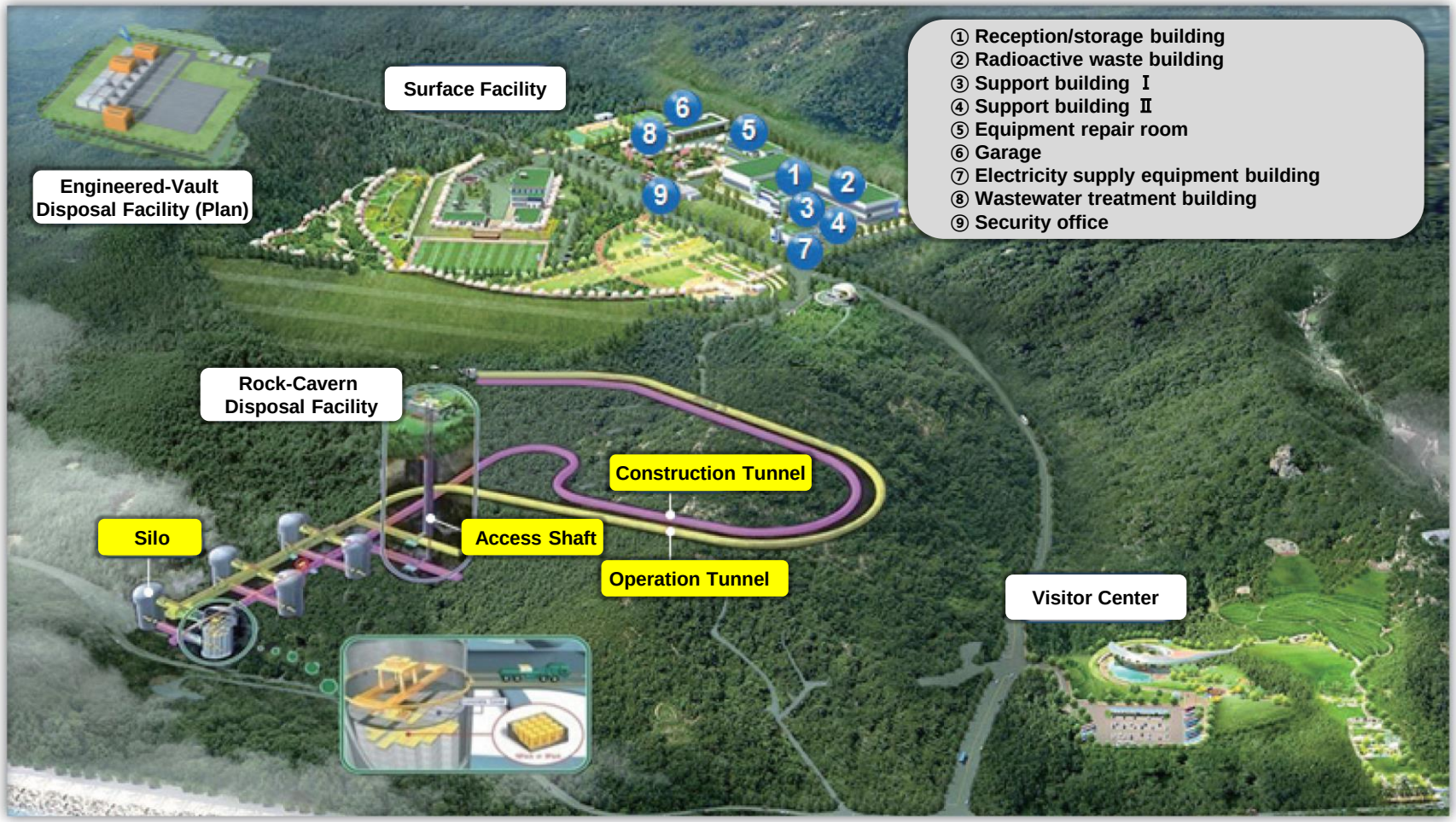
- 1st Phase: 100,000 drums (2014)
- 2nd Phase: 125,000 drums (2019)
- 3rd Phase: On Planning

☐ Disposal Type

- 1st Phase: Rock-Cavern Type
- 2nd Phase: Engineered-Vault Type
- 3rd Phase: On Planning

Overview of Wolsong LILW Disposal Facility

☐ Bird's Eye View



Lessons Learned from Korean Siting Experiences

1. Radioactive Waste Management Plan should be established as early as possible (possibly when NPP introduction is decided).

2. Clear and transparent siting process with reasonable incentive package

3. Define Stakeholders and find different approaches (General Public, Local Residents, Anti-nuclear Group etc.)

4. Listen to Stakeholders from the beginning (Specially to local groups)

5. Local residents have different objectives from other NGO's.

6. Build-up trust on Safety Issues

Public Engagement on HLW Management Policy-making

Progress of HLW Management Policy

1 Oct. 2013~Jun. 2015 : Public Engagement Commission on SNF(PECOS)

- collected opinions of the public, local residents of NPP areas and stakeholders through town hall meetings, deliberative poll, etc.
  (about 370,000 people participated)
- submitted the recommendation report to the government (Jun. 2015)

Town hall meeting

Discussion at the National Assembly

Deliberative Poll

2 Jul. 2015~Apr. 2016 : TFT for national plan for HLW management

- was organized consisting of 50 people(including experts of academic field, related organizations, and government agencies and lawyers) for have in-depth review of the draft national plan

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

- All the relevant information should be open to the public.
- HLW management project should be under the public consensus.

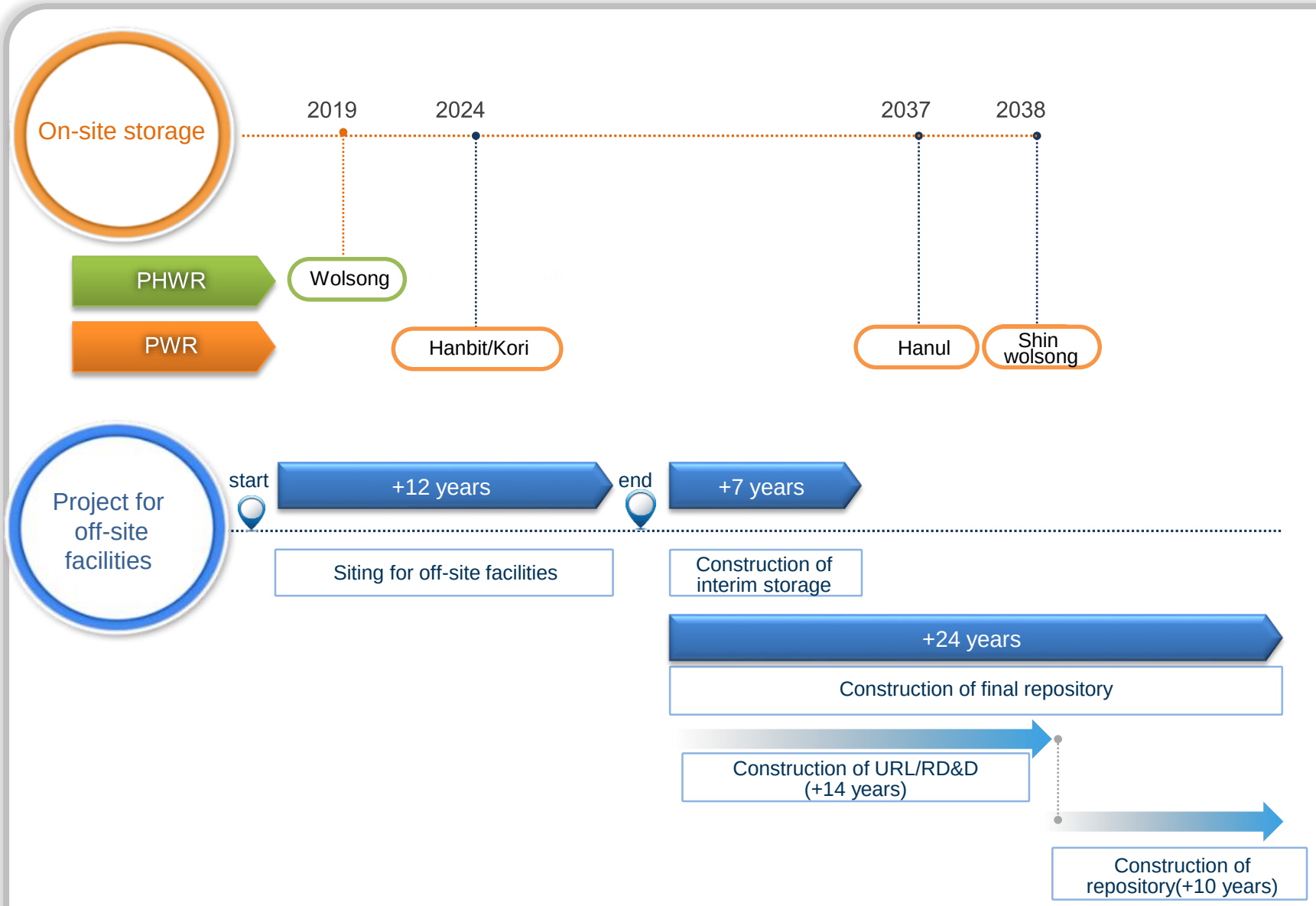
4 Due burden on present generation

- 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

Milestone of HLW management plan



KEY : Listening to Stakeholders

Study on Multilateral Management Options for Spent Nuclear Fuels in Northeast Asia using Multi-criteria Evaluation

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Motivation

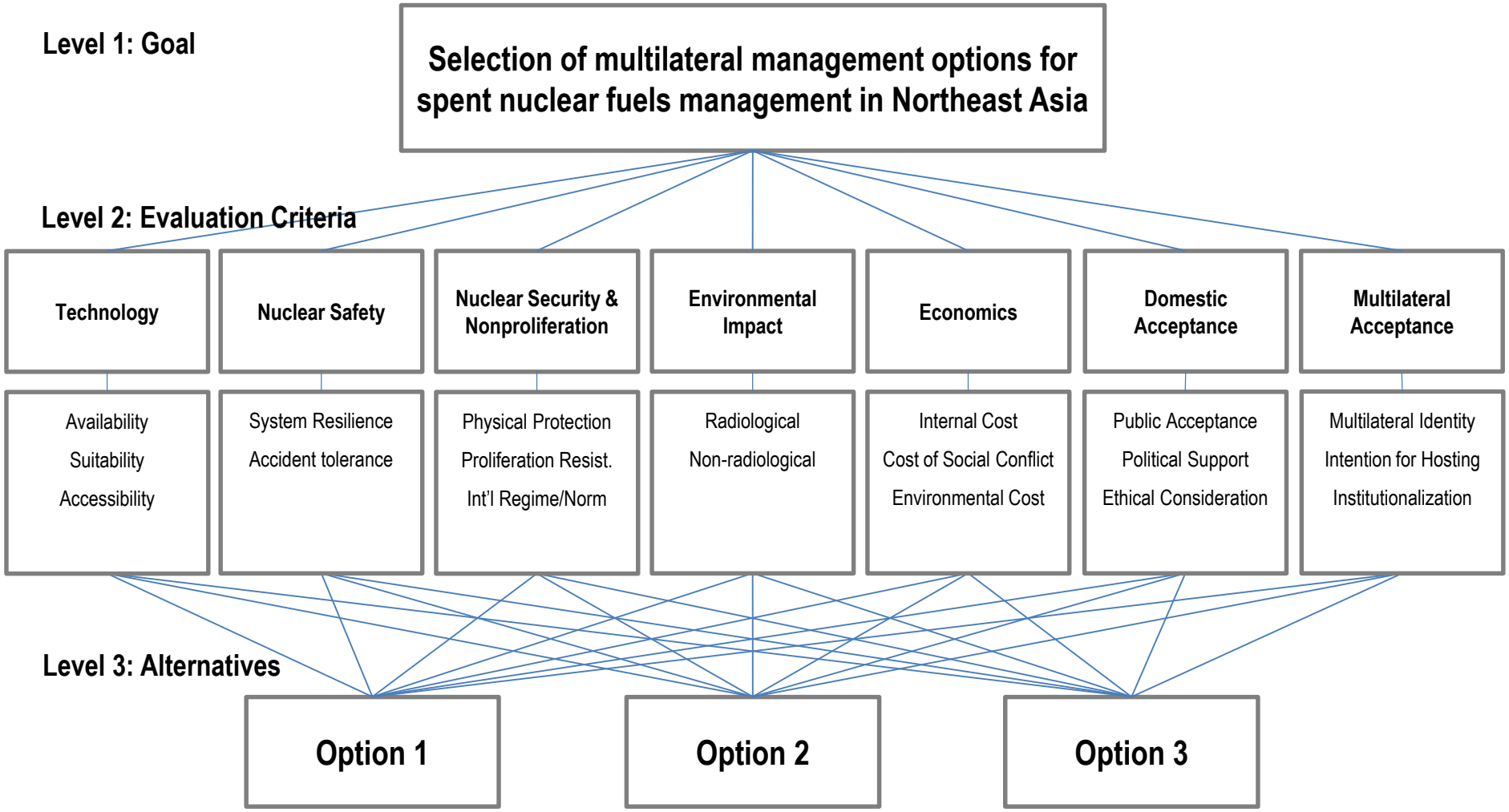
- Problem of SNF management in Northeast Asian region including Korea
- Need to consider multilateral management options for SNF management in Northeast Asia
- Require an holistic evaluation for multilateral management options for SNFs

Multilateral SNF Management Options

Option	Description	Key Technology	Potential Partner
#1 **Regional SNF repository**	- Simplest solution for SNF disposal - Requirement for geological stability - Non-nuclear state can be a host	Geological disposal or deep repository; transportation	ROK, Taiwan, Japan, Australia and USA (+ IAEA)
#2 **Regional reprocessing and storage**	- Utilizing regional reprocessing cap. - Assurance of service supply - Joint control of separated Pu/U/MA	Reprocessing (e.g. PUREX); storage of TRUs elements; transportation	ROK, Taiwan, Japan, China, USA and Russia (+ IAEA)
#3 **Multilateral partitioning and transmutation**	- Based on innovative technologies - Reducing burden of high-level waste disposal - Need to cooperate from R&D step	Partitioning (metallurgical process) and transmutation (fast reactor or ADS); transportation	ROK, Taiwan, Japan, China and USA (+ IAEA)

* PUREX: Plutonium Uranium Extraction
* TRUs: Transuranic elements
* ADS: Accelerator-driven System

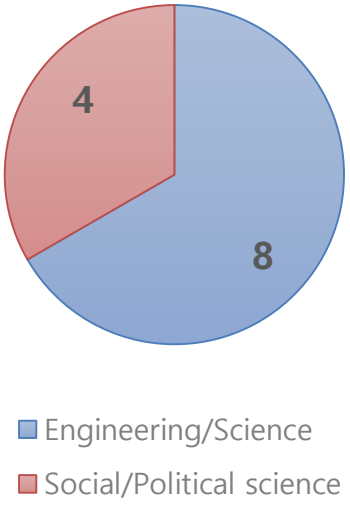
Evaluation by Analytic Hierarchy Process



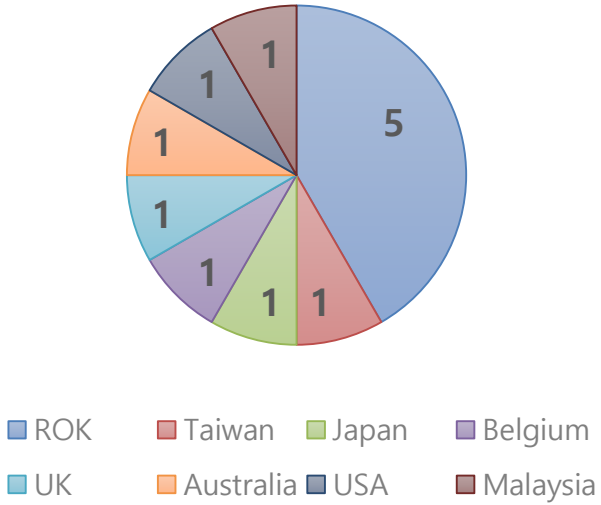
Expert Survey

- **Expert selection**
  - Use the generalized AHP method
  - Period: 15 March – 30 May 2016
  - 12 selected experts on the issue of SNF management
  - Avg. work experience: **29.6 years**

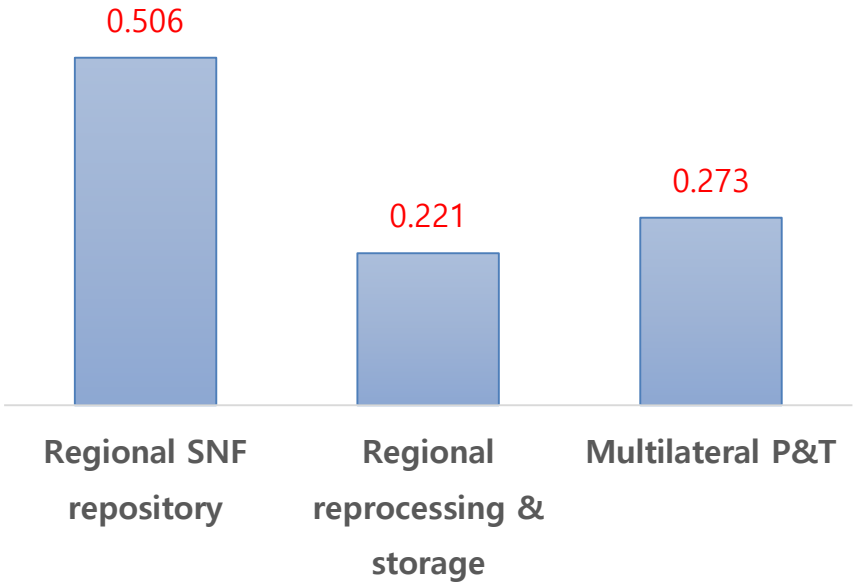
Experts Academic background



Nationality of Experts



Expert Survey Results



- **Collective opinions of experts group**
  - Experts prefer option #1(Regional SNF repository) as a multilateral strategy for SNF management in NEA region
  - This scenario earns high ratings in the key criterions (Nuclear security & nonproliferation, nuclear safety)
  - In multilateral SNF management, technical and economic criteria are lower prioritized
  - Scenario #3 (Multilateral P&T) is slightly preferred than #2 (Regional reprocessing & storage); one of noticeable result is that scenario #3 overwhelms others in the aspects of all criterions on domestic and multilateral acceptances

Thank you for your attention