The ROK’s Nuclear Energy Development and Spent Fuel Management Plans and Options

Jungmin KANG
Visiting Professor, KAIST

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April 13-15, 2012
Status & Prospects of Nuclear Power

Figure. NPPs sites in the ROK
## Status & Prospects of Nuclear Power

### Table. Current and planned nuclear power in the ROK

<table>
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<th>Unit</th>
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Reactors at Kori

Figure. The Kori nuclear power plants site (Google Earth, October 10, 2010)
Reactors at Yonggwang

Figure. The Yonggwang nuclear power plants site (Google Earth, October 10, 2010)
Reactors at Ulchin

Figure. The Ulchin nuclear power plants site (Google Earth, October 10, 2010)
Reactors at Wolsong

Figure. The Wolsong nuclear power plants site (Google Earth, October 10, 2010)
Status & Prospects of Nuclear Power (cont)

- Kori site: 6 PWRs in operation;
- Shin-Kori site: 6 PWRs under construction
- Yonggwang site: 6 PWRs in operation
- Ulchin site: 6 PWRs in operation;
  4 PWRs under construction
- Wolsung site: 4 CANDUs in operation;
  1 PWR in operation;
  1 PWR under construction

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<td>31 (31.5)</td>
<td>39 (42.7)</td>
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Status & Prospects of Nuclear Power (cont)

Figure. Installed nuclear capacity in South Korea (1980-2030)

42.7 GWe
Radioactive Waste Management Act

- Has been effective since Jan 1, 2009.
- Establishing a new organization and fund for radioactive waste management.
  - Korea Radioactive Waste Management Company (KRMC)
  - Radioactive Waste Management Fund
Radioactive Waste Management Organizations

Radioactive Waste Management

Ministry of Knowledge Economy
- Korea Hydro & Nuclear Power Co.
  - NPP Operator
- Korea RWM Co.
  - RWM Implementer

Ministry of Education, Science & Technology
- Korea Atomic Energy Research Institute
- Korea Institute of Nuclear Safety
  - Nuclear Safety Regulator
  - R&D for National RWM Program

*(Quoted from a presentation material of Jongwon Choi of KAERI on Nov. 4, 2010)*
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 South Korea 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.
Generation of Spent Fuel and Shortage of Spent Fuel Storage Capacity

- **Inventory of Spent Fuels**
  - Discharging about 290 metric tons of heavy metal (tHM) of PWR spent fuels from 16 PWRs per year and about 380 tHM of HWR spent fuels from 4 HWRs per year

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<th>Site</th>
<th>Reactor type</th>
<th># of reactors</th>
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</table>

- **Shortage of On-site Spent Fuel Storage Capacities**
  - Interim storage of spent fuel is a hot issue as its at-reactor spent fuel storage pools become saturated.
  - KHNP, a utility company argues that the storage pools at its three PWRs sites, Kori, Ulchin and Yonggwang are projected to be full by 2016, 2018 and 2021 respectively while its HWRs site, Wolsong is projected to be full by 2017 considering current on-site dry storage.
  - It has been said that on-site spent fuel storage expansion is challenge due to an anticipated strong opposition by local communities.
Figure. Cumulative inventory of spent fuel generation in South Korea (2000-2050)
Spent Fuel Storage at Kori

- When KHNP has stated that the spent fuel pools at Kori will be full in 2016, it just had considered intra-site transshipment of spent fuel among pools of old 4 reactors, i.e., Kori unit 1 to unit 4 on the site.

- The old spent fuel in the pools of the old 4 reactors can be shifted to the pools of new two reactors, i.e., Shin-Kori unit 1 and unit 2 being built on the same site. If implemented, this extends the saturation year from 2016 to 2023.
Spent Fuel Storage at Ulchin

- When KHNP has stated that the spent fuel pools at Ulchin will be full in 2018, it just had considered intra-site transshipment of spent fuel among pools of old 6 reactors, i.e., Ulchin unit 1 to unit 6 on the site.

- The old spent fuel in the pools of the old 6 reactors can be shifted to the pools of new four reactors, i.e., Shin-Ulchin unit 1 to unit 4 being built on some of the same site. If implemented, this extends the saturation year from 2018 to 2028.
Spent Fuel Storage at Yonggwang

- KHNP has stated that the spent fuel pools at Yonggwang will be full in 2021, considering re-racking of storage pools. There is no plan of new deployment of NPPs at Yonggwang at least by 2024.
Spent Fuel Storage at Wolsong

- According to a law entitled “Special Act on Support for Areas Hosting Low and Intermediate Level Radioactive Waste (LILW) Disposal Facility” in 2005, spent fuel related facilities cannot be built in the local area that hosts the LILW site, containing Wolsong site.

- Some of South Korean nuclear experts argue that it means that no more dry storage facilities are to be built after 2017 when current dry storage will be full.

- However, Korea Radioactive Waste Management Corporation (KRMC) argues that those dry storage facilities at Wolsong are tentative ones, not for interim storage that are banned by the special Act of LILW.


- Whether or not dry storage facilities at Wolsong violate the special Act of LILW is still controversial and needs to be clear.
Dry Storage Facilities at Wolsong

Figure. Concrete silo and MACSTOR/KN-400 at Wolsong (Google Earth, October 10, 2010)
Concrete Silo at Wolsong

- Concrete Silo
  - Storage capacity: 10.4 tHM
  - Out diameter: 3.1 m
  - Height: 6.5 m

- 300 concrete silos (3,120 tHM) have been installed at Wolsong since 1990.
MACSTOR/KN-400 at Wolsong

- MACSTOR/KN-400
  - Storage capacity: 461 tHM
  - Dimension: 22 m (L) x 12.5 m (W) x 7.5 m (H)
  - Height: 6.5 m
- 7 MACSTOR/KN-400 modules (3,227 tHM) have been installed at Wolsong since 1990.
# Current, Planned and Potential Spent Fuel Storage Capacity through 2021

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<th>Site</th>
<th>Unit</th>
<th>Type</th>
<th>Capacity (GWe)</th>
<th>Operation (year.month)</th>
<th>Pool storage capacity (tons)</th>
<th>Existing</th>
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<th>Planned</th>
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Modified Saturation Time of Spent Fuel Storage

- “Alternatives and Roadmap of Spent Fuel Management in South Korea” on Aug. 19, 2011
  - Performed by an expert group composed of members of South Korea’s nuclear establishment (Korean Nuclear Society, Korean Radioactive Waste Society and Green Korea 21)
  - The storage pools at sites, Kori, Ulchin and Yonggwang, Wolsong are projected to be full by 2028, 2028, 2024 and 2025, considering re-racking and transshipment between NPPs at PWRs sites and installing two additional MACSTOR/KN-400 modules at Wolsong.
KAERI’s Plan on Pyroprocessing and Fast Reactors

Approved by AEC in 2008

- Gen IV SFR
  - Advanced Design Concept
  - System Performance Test
  - Standard Design
  - Detailed Design
  - Licensing Technology Development
  - Demo Plant
  - Fuel Irradiation Test
  - Mock-up Pyro Facility (Nat. U) 10t/yr
  - Eng.-scale Pyro Facility (Hotcell) 10t/yr
  - Prototype Pyro Facility 100t/yr
  - Prototype Pyro Facility Operation

(Quoted from a presentation material of Hansoo Lee of KAERI in 2010)
Concluding Remarks

- Interim storage of spent fuel would be key factor affecting nuclear fuel cycle activities and development in the ROK in the coming years.
- A 10-year US-ROK joint study on pyroprocessing, which has started in 2012, would affect future nuclear fuel cycle activities and development in the ROK.