The Search for Interim Spent Nuclear Fuel Storage in South Korea

Recommended Citation

Jungmin Kang, "The Search for Interim Spent Nuclear Fuel Storage in South Korea", NAPSNet Special Reports, August 31, 2015, https://nautilus.org/napsnet/napsnet-special-reports/the-search-for-interim-spent-nuclear-fuel-storage-in-south-korea/

By Jungmin Kang

31 August 2015

I. Introduction

Plans call for a continued expansion in South Korea's fleet of nuclear reactors, but at the same time, facilities for the temporary storage of spent fuel, mostly in at-reactor pools, continue to fill up. Negotiations between the nuclear industry and central government agencies on one side, and local host communities on the other, for siting of interim spent fuel storage facilities, let alone permanent waste disposal facilities, have been largely ineffective to date, due in large part to a combination of the tactics used by authorities in approaching local communities, and a lack of unbiased information about nuclear facilities on the part of local stakeholders. In the last few years, a new effort to engage host communities has been undertaken, and shows some promise, though much work remains before agreements on facility siting can be reached.

This paper was originally published with support from the Hanyang University's Energy, Governance and Security (EGS) Center, available in Global Energy Monitor Vol. 3, No. 5 (May 2015).

A longer version of this article was published as Jungmin Kang, S.-W. Kim, and Byong-Chul Lee (2015), "Hot potato in South Korea: The spent nuclear fuel storage dilemma" in *The Bulletin of the Atomic Scientists*, May/June issue (Volume 71, Issue 3), available as http://thebulletin.org/2015/may/hot-potato-south-korea-spent-nuclear-fuel-storage-dilemma8298.

Dr. Jungmin Kang is currently a visiting professor at the Korea Advanced Institute of Science and Technology, South Korea. His recent research interests include advanced nuclear fuel cycles and spent fuel management, particularly in the context of the South Korean nuclear energy sector.

II. Special Report by Jungmin Kang

The Search for Interim Spent Nuclear Fuel Storage in South Korea

Plans call for a continued expansion in South Korea's fleet of nuclear reactors, but at the same time, facilities for the temporary storage of spent fuel, mostly in at-reactor pools, continue to fill up. Negotiations between the nuclear industry and central government agencies on one side, and local host communities on the other, for siting of interim spent fuel storage facilities, let alone permanent waste disposal facilities, have been largely ineffective to date, due in large part to a combination of the tactics used by authorities in approaching local communities, and a lack of unbiased information about nuclear facilities on the part of local stakeholders. In the last few years, a new effort to engage host communities has been undertaken, and shows some promise, though much work remains before agreements on facility siting can be reached.

Nuclear Spent Fuel is Accumulating at Reactor Sites in South Korea

As of 2015 about 760 metric tons of spent fuel is discharged annually from 23 reactors in South Korea.[1] About half of this total comes from four CANDU heavy water reactors (HWRs) and the other half from 19 pressurized light-water reactors (PWRs).[2] As of the end of 2013, 6,541 tHM (tonnes heavy metal) in spent PWR fuel and 7,258 tHM in spent HWR fuel were stored in the spent fuel storage facilities at four different nuclear power plants clustered into four coastal sites: Hanul

(Ulchin), Wolsong and Kori along the East coast and Hanbit (Yonggwang) on the West coast.

By 2035, the government plans to have 16 more reactors online, bringing the country's total nuclear generating capacity to 42.7 gigawatts (GW).[3] It is estimated that approximately 51,400 metric tons of spent PWR fuel and 19,400 metric tons of spent HWR fuel will be generated over the extended lifetimes of the 35 pressurized water reactors and 4 heavy water reactors units that are currently operating and are to be deployed by 2035. These projections are based on an assumed thermal to electric power conversion efficiency of 33%, an average 90% capacity factor, and average fuel burn-ups at the time of spent fuel discharge for PWR and HWR fuel of 50 and 7.1 GWd/tHM, respectively.

As the existing at-reactor storage pools fill up, spent fuel management has become a hot-button issue in South Korea. Korea Hydro & Nuclear Power Co., Ltd. (KHNP), South Korea's electric-power utility, argued in 2008 that the saturation dates for the current spent fuel storage capacity at the three PWR sites—Kori, Hanbit and Hanul—and at the Wolsong HWR site, would be 2016, 2021, 2018 and 2017, respectively.[4] KHNP did not fully consider intra-site trans-shipment of spent fuel, however, or the potential for dense-racking arrangement of spent fuel assemblies in pools—"re-racking" was assumed in the spent fuel pools of some reactors but not in others.

In 2011, the Korea Radioactive Waste Agency (KORAD, previously KRMC) published a reassessment performed by an expert group composed of members of the South Korea's nuclear establishment, which found that the storage pools at Kori, Hanbit, Hanul and Wolsong will be full by 2028, 2024, 2028 and 2025, respectively.[5]

When re-racking and transfers between pools on the same site are considered, Kori will be full in 2031 and Hanul and Hanbit in 2028 and 2023, respectively, based on the author's calculation using recent KHNP data.[6] Taking into account additional planned MACSTOR/KN-400 dry-storage modules at Wolsong facilities, the storage capacity at Wolsong will be full in 2027. These results are not very different from those obtained by the KORAD group.

Compared with the PWR sites, the spent-fuel storage situation at Wolsong is more complex. According to a 2005 law, the "Special Act on Support for Areas Hosting the Low and Intermediate Level Radioactive Waste (LILW) Disposal Facility," spent fuel-related facilities cannot be built in the locality that hosts the national LILW site. That site is in the same local jurisdiction as the Wolsong site. Some South Korean nuclear experts interpret the law as follows: no more dry storage facilities can be built at Wolsong after 2017 when the current dry storage facilities there will be full. However, KORAD claims that the dry storage facilities at Wolsong are "tentative," not the "interim" storage that is banned by the 2005 Special Act of LILW. KORAD understands the term "tentative" storage to mean storage of spent fuel on-site under the control of KHNP, whereas "interim" storage is understood to mean storage of spent fuel on a reactor site or at an away-from-reactor (AFR) site under the control of KORAD.

Legal Basis for Spent Fuel Management in South Korea

At its 253rd meeting in 2004, the Korean Atomic Energy Committee (AEC) announced that a national policy for spent fuel management would be decided upon later in consideration of progress of domestic and international technology development, and that spent fuel would be stored at reactor sites through 2016 under KHNP's responsibility.[7] Since South Korea has not decided whether to directly dispose of or recycle spent fuel, it currently has no national plan with regard to geologic disposal facilities for spent fuel.

In South Korea, the Atomic Energy Committee (AEC), consisting of 8 to 10 members including several ministers, and chaired by Prime Minister, is the ultimate organization for decision-making on

national nuclear policies, budget, and regulations. With regard to the radioactive waste, the main administrative authorities are the Ministry of Trade, Industry and Energy (MOTIE, previously the Ministry of the Knowledge Economy) and the Nuclear Safety and Security Commission (NSSC) under the jurisdiction of the Prime Minister. MOTIE supervises the nuclear power program, while the NSSC is responsible for nuclear safety and security regulations, including the licensing of nuclear facilities.[8]

The NSSC is also in charge of developing licensing criteria for the construction and operation of radioactive waste disposal facilities, of developing technical standards for operational safety measures, and of assuring safe management of radioactive waste at every stage of waste disposal, including the site selection, design, construction, operation, closure and post-closure phases. MOTIE develops and implements management policies regarding radioactive waste treatment, storage and disposal. These policies are prepared by MOTIE and must be approved by the AEC before implementation.

Public Engagement Commission on Spent Nuclear Fuel Management

In October 2013, given the increasing urgency to develop measures to address long-term radioactive waste management, South Korea's government launched a Public Engagement Commission on Spent Nuclear Fuel Management (PECOS) to consult with a variety of sectors and make recommendations on options of resolving spent fuel problem by the end of 2014.[9] PECOS has 13 members, including specialists on energy, social sciences and conflict management, non-governmental organizations (NGOs), and representatives of the nuclear power plant host regions. The launch of PECOS may be a critical turning point in what has been four decades of impasse for the South Korean SNF management program.

Thus far, PECOS has emphasized the importance of interim spent fuel storage. It has made little progress, however, in engaging the local communities that host South Korea's nuclear power plants. Instead, the commission has been focusing on its media strategy. When it became evident that PECOS had failed to produce any specific recommendation by the end of 2014, its end date was postponed to the end of June, 2015.

Despite PECOS' efforts to ease their concerns about the problem of filling on-site storage capacity, civic groups and the local public alike have offered quite a frosty response thus far, in part due to popular discontent with the government's requirement that PECOS find a quick solution (within a year) to the spent fuel management problem.

Increasing popular apprehension about the safety of nuclear power plants will naturally affect residents' concerns about spent fuel management issues. The author confirms this concern as a result of his visits to each of the nuclear power plant sites in South Korea. At all of the sites visited, the author found local opinion leaders making clear their concerns about the safety of spent fuel management in addition to their concerns about the overall safety of nuclear power plant operations. Opinion leaders made clear that any decision to address spent fuel storage problem should include measures to assure that spent fuel storage arrangements are safe.

Lessons from Legacies

Research on the design of and potential siting options for centralized facilities for interim spent fuel storage and disposal of low- and intermediate-level nuclear waste (LILW) began in 1986 in South Korea. In 1988 the Korean Atomic Energy Commission announced that an away-from-reactor repository would be completed by the end of 1997. The plan to develop the repository failed eventually due mainly to strong opposition from potential site communities. Local opposition was

aggravated by the alienation of local residents during the site selection process, when officials and nuclear industry representatives generally ignored the voices of local communities. Ever since there have been no serious attempts for a nuclear waste repository. In 1996, the responsibility for radioactive waste management was transferred first to the then Ministry of Commerce, Industry and Energy, then on to KEPCO (the Korean Electric Power Company). In September 1998, AEC announced that a low- and intermediate-level waste repository would be completed by 2008, and an interim spent fuel storage facility would be built by 2016, with an additional 2,000 ton capacity dry storage facility nearby.

In the face of continuing difficulties in siting nuclear waste facilities, including years of adamant opposition on the part of potential hosting communities, the AEC finally separated the issue of management of low- and intermediate-level waste from that of management of spent fuel, and thus may be able to claim some success by winning local endorsement for LILW storage in Kyeongju. This time a totally new and, relative to previous attempts to engage host communities, uncharacteristic approach by the South Korean government produced a favorable result: a thorough and transparent consultation with local government, offers of financial incentives inducing local voluntarism, and accepting local demands helped to result in a successful siting decision.[10]

Indeed, history in other countries abounds with successful facility siting processes carried out in similar situations: Canada, Sweden, Finland, and the UK also have experiences to share. These countries took years, even decades, to understand that it was not the act of scientific persuasion nor will of the government/utility, but rather consultation with local communities that finally saved the expenditure of further unnecessary time, effort, and budget that would be otherwise wasted in the siting of a nuclear waste repository. South Korea's earlier failure could thus have been foreseen when the South Korean government excluded local communities in its unilateral siting drive. South Korea's previous approach was a typical example of what in the UK is called the "DADA" or "decide, announce, defend, and abandon" process.

Conclusions

Residents in localities hosting nuclear power plants are anxious about the dangers associated with the plants. Their general level of understanding of nuclear spent fuel issues, however, is low. The reasons are many-fold, but the primary cause seems to be that residents typically have not been given sufficient balanced information about the urgency of additional spent fuel storage.

Having spent a whole year in agenda setup and internal education and discourse, PECOS has only recently begun to reach out to communities hosting nuclear power plants, even as the nominal date for finalizing the PECOS discussions has been postponed to June 2015. The commission has a stated desire to listen to local voices representing diverse interests. Up to now, however, PECOS' engagements in regions hosting nuclear power plant have been limited.

As they grapple with safety concerns regarding nearby nuclear facilities, local residents typically lack unbiased information on the issues involved. This need for information must be properly addressed for a transparent public policy process to take place. PECOS is expected and ought to carry out its due diligence by taking into account various local voices and seeking to understand and engage with the intricate web of diverse interests present at each of the sites, as well as to provide proper and objective facts regarding spent fuel management to local residents in nuclear power plants areas, as well as to general public.

Lastly, though different perspectives co-exist among local residents, the research undertaken by the author and his colleagues has identified one way to fill the information gap faced by nuclear facility host communities. Educational information from independent experts seems to be an effective way

to impart an understanding of the spent fuel storage situation and options. Providing such information could increase the level of discourse at the local level and make the national spent fuel management policy debate more rational.

Image: **ABC News**

III. References

[1] Out of 23 nuclear power reactors, 19 are PWRs located at Kori, Hanbit, Hanul and Wolsong and 4 are HWRs at Wolsong.

[2] Because HWRs use unenriched uranium, the mass of spent fuel produced by these units is much greater, per reactor year of operation, than the mass of spent fuel produced per reactor-year of operation of PWRs, which use enriched uranium.

[3] Ministry of Trade, Industry and Energy (2014), "The second national energy basic plan," January 2014 (Korean).

[4] Ki-Chul Park (2008), "Status and Prospect of Spent Fuel Management in South Korea," *Nuclear Industry*, August 2008 (Korean).

[5] Korea Radioactive Waste Management Corporation (2011), *Alternatives and Roadmap of Spent Fuel Management in South Korea* final report prepared by Korean Nuclear Society, Korean Radioactive Waste Society and Green Korea 21, August 2011 (Korean).

[6] Private communication with KHNP, August 2014.

[7] Press Release, 253rd meeting of Korean AEC in 2004, 17 December (Korean).

[8] See http://www.nssc.go.kr/nssc/english/introduction/purpose.html.

[9] Doo-Seung Hong (2014), "Status and Prospects of Public Engagement Commission on Spent Nuclear Fuel Management," June 25, 2014.

[10] H Feiveson, Z Mian, MV Ramana, and F von Hippel eds (2011)., "Managing Spent Fuel from Nuclear Power Reactors: Experience and Lessons from Around the World," *IPFM*, September, 2011, pp. 62-68.

View this online at: https://nautilus.org/napsnet/napsnet-special-reports/the-search-for-interim-spent-nuclear-fuel-storage-in-south-korea/

Nautilus Institute
2342 Shattuck Ave. #300, Berkeley, CA 94704 | Phone: (510) 423-0372 | Email: nautilus@nautilus.org