Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 22-23, 2025

Siting of Small Modular Reactors in South Korea: Lessons Learned from Site Selection History

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***Keywords: Small Modular Reactors, Nuclear Policy, Siting, Public Acceptance, Risk Perception**

1. Introduction

The Korean government has emphasised the role of nuclear power in achieving carbon neutrality by 2050, as outlined in its Nationally Determined Contribution. Additionally, the 11th Basic Plan for Long-term Electricity Supply and Demand states that the first Korean small modular reactor (SMR) is planned for commercialisation by 2035, with a single SMR expected to generate 0.7 GW of electricity that year [1].

In line with this objective, active research and development dedicated to SMR technology is underway, driven by collaboration among industry, academia, and research institutions. Given the distinct characteristics of SMRs compared to conventional nuclear reactors—such as their smaller physical footprint, enhanced safety, and reduced emergency planning zone (EPZ) requirements—siting considerations must be tailored to specific designs. However, despite the anticipated deployment of this new reactor design, siting considerations remain insufficiently addressed.

Moreover, as South Korea's electricity demand is expected to rise significantly due to artificial intelligence (AI), semiconductor clusters, hydrogen production, and advanced manufacturing, the existing transmission infrastructure may not efficiently support power delivery from remote generation sites to these high-demand areas. This highlights the competitive advantage of locating SMRs closer to demand centres, minimising transmission losses and ensuring a stable power supply. Some big tech companies are already exploring this option worldwide, and there is growing private sector investment and research into deploying SMRs adjacent to data centres and industrial facilities, including in South Korea.

South Korea currently operates 26 nuclear reactors across five regions. The five existing nuclear power plant (NPP) sites were selected decades ago, considering electricity demand and regional balanced development. Since then, the Korean government has not secured any additional NPP sites and has instead focused on expanding existing plants by adding new units to current sites or extending the lifespan of reactors originally scheduled for decommissioning.

To successfully commercialise SMRs, proactive siting decisions must be made, and policies and regulations must be adapted to accommodate their unique design characteristics. This paper examines the historical site selection process of nuclear power plants in South Korea, with a focus on the lessons learned from the siting of Kori Unit 1 and the cancellation of the Daejin NPP site in Samcheok-si. Based on these insights, considerations for the siting of future SMRs are proposed.

2. Site Selection History

2.1. Site Selection History in the Early Stages of the Korean Nuclear Power Programme (1960s ~ 1970s)

The site selection process in the early stages of a nuclear power programme is typically led by the government. The Korean Nuclear Power Programme was initiated after the Korean and U.S. governments signed a bilateral agreement on atomic energy in 1956. Following the rapid economic and industrial development of the late 1950s and early 1960s, electricity demand increased significantly. In response, the government launched a site survey for the country's first NPP, conducted under the supervision of the Korea Atomic Energy Research Institute in collaboration with Korea Electric Power Corporation [2].

Since electricity demand was highest in Seoul and the industrial regions of Busan and Ulsan, the government prioritised these areas for NPP construction. The site survey committee assessed potential locations based on geological stability and water supply capacity, selecting Hangju-gun (Gyeonggi-do), Gijang-myeon and Jangan-myeon in Dongrae-gun (Gyeongsangnam-do). A site survey team from the International Atomic Energy Agency later conducted feasibility assessments, reviewing geological stability, environmental impact, and overall site suitability. Ultimately, Gijang-myeon was selected as the host site for the first NPP (Kori) [3].

In October 1967, the construction of the first NPP at the Kori site was officially confirmed in the Long-term Plan for Electric Power Development. According to this plan, the construction schedule was finalized in 1969, followed by land acquisition, compensation, and the relocation of residents.

Similar to the first site, the Wolsong site in Gyeongju-si and the Hanbit site in Yeonggwang-gun were selected in 1975 and 1977 respectively through government decisions, taking into account electricity demand and balanced regional development. An overview of the Korean Nuclear Power Programme is presented in Figure 1 below.

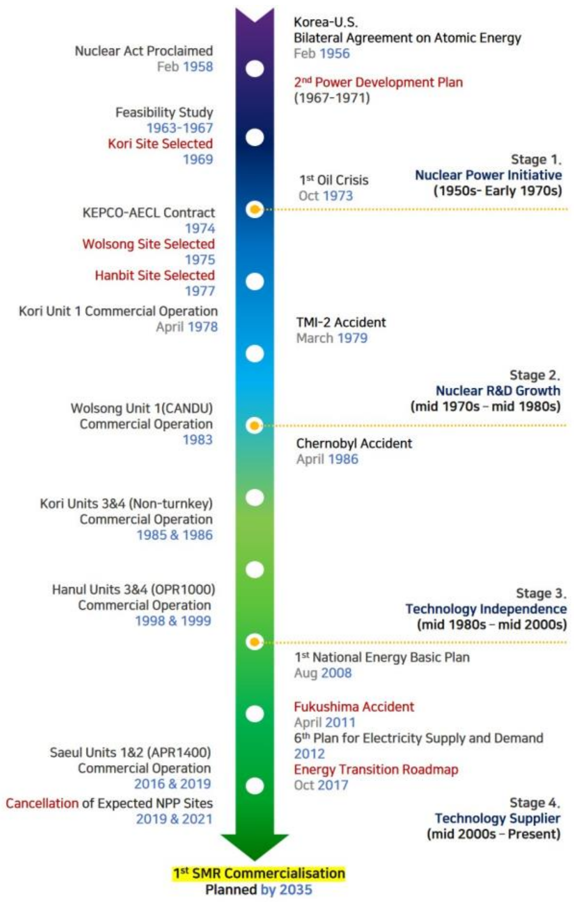

Fig 1. Overview of the Korean nuclear power programme.

2.2. Cancellation of Site Selection (2000s~Present)

According to the 1st National Energy Basic Plan (2008), the Korean government considered adding two new APR1400 NPP sites. In response, Korea Hydro & Nuclear Power (KHNP) invited local governments to apply, leading to the designation of Yeongdeok (Cheonji NPP) and Samcheok (Daejin NPP) in 2012; later reinforced by the 6th Basic Plan for Electricity Supply and Demand (2013–2027) [4].

However, the 2017 Energy Transition Policy led to the cancellation of new NPPs. As such, KHNP terminated the Yeongdeok project in 2018, and after a public hearing in February 2021, its designation was officially revoked in March 2021.

Meanwhile, Samcheok faced strong opposition, particularly after the 2011 Fukushima accident. Resistance intensified following the election of an anti-nuclear mayor in 2014, leading the city government to push for a referendum. However, the referendum was deemed legally invalid under the Residents' Voting Act [4]. In response, residents organized an unofficial vote, in which 84.97% opposed the project.

The strong local opposition resulted in ongoing conflicts between residents, local stakeholders, and national policymakers. With the implementation of the Energy Transition Policy, the project was ultimately cancelled in June 2019, and Samcheok's designation as a nuclear power plant site was officially revoked.

3. Lessons Learned

3.1. Government-led Site Selection in the Early Stages

In the early stages of South Korea's nuclear power programme, site selection was predominantly government-led. Given the country's rapid economic growth and the urgent need for a stable electricity supply, technical factors such as electricity demand, geological stability, and environmental feasibility were prioritised. The initial NPP sites—Kori, Wolsong, and Hanbit—were selected based on these criteria, with minimal public engagement.

3.2. Challenges in Public Acceptance

As demonstrated in the case of the Samcheok Daejin NPP, excluding public participation from site selection can lead to strong opposition. While the project was ultimately cancelled due to a policy transition, it faced intensified resistance and ongoing disputes in Samcheok. This case illustrates that site selection processes lacking public consensus are susceptible to prolonged conflicts and policy reversals.

3.3. Challenges in Risk Perception

As demonstrated in the case of the energy policy transition in 2017 and Samcheok Daejin NPP, public perception of risk can significantly influence public opinion. While SMRs offer enhanced safety features, the risks perceived by the public may differ from their actual risks. Therefore, strategies to address and mitigate public risk perception should be carefully developed.

3.4. Legal and Institutional Constraints

While Korean legislation, such as the *Electric Power Source Development Promotion Act*, acknowledges the need for public consultation in site selection, its practical implementation remains ambiguous. Existing regulatory frameworks have struggled to prevent disputes and delays, as mechanisms to incorporate local opposition effectively into final decisions remain underdeveloped.

4. Policy Implications

Successfully deploying SMRs in South Korea requires a new siting approach that considers demand-driven placement, regulatory updates, and public acceptance strategies. Key policy implications are as follows:

(1) Considerations for SMRs Siting

Globally, there is growing interest in deploying SMRs near industrial hubs and data centres to provide stable, localised power. Given South Korea's concentrated high-tech industries and increasing electricity demand, adopting a demand-driven siting approach for SMRs could enhance grid stability and reduce transmission losses.

SMRs' compact design and enhanced safety allow for more flexible siting than conventional reactors. Policymakers must establish clear guidelines balancing safety, efficiency, and public acceptance to ensure effective deployment.

(2) Regulatory Adaptation for SMR Deployment

Existing regulations were designed for large-scale reactors, necessitating updates to accommodate SMRs' design characteristics to enable them to be placed closer to demand centres.

(3) Strengthening Public Engagement and Addressing Risk Perception

A lack of public participation in past nuclear projects has led to opposition and delays. For SMRs, ensuring early-stage consultations, transparent communication, and structured public engagement will be essential to prevent similar challenges.

Despite their enhanced safety, public perception of SMRs' risks remains a barrier. Effectively bridging the gap between perceived and actual risks while fostering trust will be critical for securing public acceptance.

(4) Managing Multi-Site Deployment Challenges

The smaller footprint of SMRs allows for deployment across multiple sites, but this also increases stakeholder involvement, potentially leading to more opposition. To mitigate conflicts, structured engagement strategies should be considered. Alternately, economic incentives may be a good option. Proactively managing these complexities will be essential for smooth SMR deployment near demand centres.

(5) Proactive Policy Planning for Future Nuclear Expansion

The case of Daejin NPP shows the risks of reactive policymaking, where siting decisions face unexpected reversals due to changing public sentiment and energy policies. A long-term, stable strategy that integrates public opinion, economic needs, and technological advancements is essential for the successful deployment of next-generation reactors.

5. Conclusion

This study examined the historical site selection processes for nuclear power plants in South Korea, highlighting the government-led approach during the early stages and analysing public opposition and policy shifts that led to the cancellation of the Daejin NPP. These cases underline the increasing importance of public acceptance and proactive policymaking in nuclear infrastructure decisions.

The analysis demonstrates that future SMR deployment requires a fundamentally different siting strategy. As SMRs offer enhanced flexibility in siting due to their smaller footprint, improved safety features, and reduced EPZ requirements, this makes them particularly suitable for deployment near high-demand areas driven by AI infrastructure, semiconductor clusters, and high-tech industries. However, the experience from the Daejin NPP highlights risks associated with reactive policymaking, inadequate public engagement, and rigid regulations. Public scepticism remains a critical barrier, requiring effective risk communication, structured stakeholder involvement, and transparent safety assessments.

Therefore, successful commercialisation of SMRs in South Korea will depend on proactive siting strategies that integrate lessons learned from past experiences, including early-stage public engagement, regulatory flexibility tailored specifically for SMRs, and clear, targeted communication addressing public concerns. To further ensure a resilient and socially acceptable SMR deployment framework, future research should explore practical approaches to enhancing public acceptance, including incentive mechanisms and willingness-to-pay studies.

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