

Applicability of Korean Siting Regulations to Light-Water SMRs for Heat Supply

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1. Introduction

Small modular reactors (SMRs) are being considered for district heating and industrial process heat. Because heat-transfer losses and pipeline costs increase with distance, the distance between the reactor and heat demand sites can become an important siting factor. This may create siting conditions different from those of conventional large nuclear power plants, where population distribution, offsite radiological consequences, emergency preparedness, and external hazards are key considerations.

In Korea, the Criteria for Restrictions on the Location of Nuclear Reactor Facilities were established in 2026, explicitly defining the low population zone and distance to a population center [1]. This study reviews the Korean framework and regulatory approaches in the United States, Canada, Finland, and the United Kingdom to identify key issues for applying Korean siting regulations to light-water-cooled SMRs for heat supply. Quantitative evaluation using design-specific source terms and accident analyses is left for future work.

2. Siting Characteristics of Heat-Supply SMRs

For heat-supply SMRs, proximity to heat demand can become a practical siting factor. Nevertheless, proximity to demand does not necessarily imply locating a reactor within a densely populated area. Site suitability should be evaluated considering reactor power, radioactive inventory, accident source term, offsite radiological consequences, population distribution, external hazards, and emergency preparedness.

The principal siting issues may differ by heat application. For district heating, population distribution and design-specific radiological consequences are important, while human-induced external hazards may be more significant for industrial process heat. Therefore, the siting issue should be addressed not simply as relaxation of existing distance criteria, but as whether the safety objectives of the existing framework can be maintained while appropriately reflecting application-specific site characteristics and design-specific safety features.

3. Current Korean Reactor Siting Regulations

The Criteria for Restrictions on the Location of Nuclear Reactor Facilities (NSSC Notice No. 2026-7), established in 2026, specify detailed requirements and radiation dose values for restrictions on reactor facility locations pursuant to the Nuclear Safety Act and the Regulation on Technical Standards for Nuclear Reactor Facilities, Etc. [1]. The Notice defines the “distance to a population center” as the distance from a reactor facility to the nearest boundary of a population center containing a residential population of 25,000 or more, and defines the “low population zone” as an area surrounding the exclusion area for which accident doses at its outer boundary are limited.

The Korean framework therefore links accident radiological consequences with population-related restrictions on reactor location. The 2026 Notice also clarified the population-center-distance restriction previously implemented with reference to U.S. criteria [1].

4. International Regulatory Approaches

In the United States, 10 CFR Part 100 uses the exclusion area, low population zone (LPZ), and population center distance (PCD) [2]. NRC RG 4.7 Rev. 4 introduced technology-inclusive, risk-informed, and performance-based alternative approaches for population-related siting of advanced reactors [3]. These approaches retain the underlying public-protection objective while allowing design-specific risk and accident consequences to support the siting demonstration.

Canada explicitly includes small reactor facilities within REGDOC-1.1.1 and permits a graded approach commensurate with facility risks and characteristics [4]. Site-evaluation information is also used and reviewed in subsequent lifecycle stages. This provides a useful example of linking site characteristics with subsequent design and safety-case development rather than establishing a separate uniform distance criterion for small reactors.

Finland provides a particularly relevant case for heat supply. Guide YVL A.2 identifies avoidance of densely populated areas as a starting point for nuclear power plant siting [5], while Steady Energy is developing the 50-MWth LDR-50 for district heating [6]. The Salmisaari full-scale pilot is non-nuclear and uses electric heaters, and the LDR-50 Joint Early Review

was a non-binding early review rather than licensing or approval of a specific site [7,8]. Thus, Finland should not be interpreted as having relaxed population-related siting requirements for LDR-50; rather, it is an emerging case in which a heat-demand-oriented reactor concept must be accommodated within an existing siting framework.

The United Kingdom applies demographic siting criteria together with detailed safety assessment, with the manner of application depending on the type of nuclear installation [9]. Overall, the four cases show a common tendency to retain existing public-protection objectives while introducing design- and risk-informed flexibility where necessary, rather than replacing the entire siting framework for new reactor technologies.

5. Applicability to Heat-Supply SMRs in Korea

A separate siting regulatory framework may not be necessary for heat-supply SMRs at this stage. A stepwise approach is more appropriate: first evaluate whether the current Korean framework can accommodate the design and application characteristics; then consider additional regulatory measures only if specific gaps are identified. The principal issues should be differentiated between district heating and industrial process heat.

Table 1. Key Siting Issues by Heat-Supply Application

Application	Siting characteristic	Key regulatory issue	Conceptual-design consideration
District heating	Location near urban/residential heat demand	LPZ and population-center distance	Source term, offsite consequences, site population
Industrial process heat	Location near industrial facilities	Human-induced external hazards	Fire/explosion/hazardous materials; separation and protection
Common	Different power and design features from large LWRs	Existing siting/technical requirements	Applicability of current framework; alternative demonstration if needed

5.1 District Heating

For district-heating SMRs, the review sequence can be expressed as: location near heat demand sites → possible location near population centers → design-specific source-term and offsite-consequence assessment → applicability of the LPZ and population-center-distance requirements. If adequate siting flexibility is demonstrated under the existing framework, regulatory relaxation may not be necessary. A risk-informed alternative similar in concept to the U.S. approach should be considered only if a specific gap is identified despite limited design-specific accident consequences.

5.2 Industrial Process Heat

For industrial process heat, the corresponding sequence is: location near heat demand sites → possible location near industrial facilities → assessment of fire, explosion, missiles, and hazardous-material releases → determination of necessary separation and design-protection measures. The relationship between heat-

transfer distance and safety-related separation or protection should therefore be considered from the conceptual-design stage.

5.3 Implications for Conceptual Design

Siting assessment should also be reflected in conceptual design. Expected population conditions can be used to establish design features that limit accident releases for district-heating applications, while representative industrial hazards can be used to establish structural and safety-system requirements for process-heat applications. The design process should therefore link expected site and heat-demand conditions, regulatory issues, design requirements, safety assessment, and site suitability.

6. Conclusion

International cases indicate that advanced reactors and SMRs do not necessarily require uniform relaxation of existing siting regulations. Instead, public-protection objectives are retained while design characteristics, accident consequences, and risk are reflected through different regulatory mechanisms. Korea should similarly evaluate the applicability of its 2026 siting framework before assuming the need for a separate framework.

For district heating, population distribution and design-specific radiological consequences are the principal issues; for industrial process heat, human-induced external hazards may be more significant. Once the reactor design is sufficiently developed, quantitative assessment using design-specific source terms, accident analyses, and representative site characteristics should be performed. Additional risk-informed methods or regulatory modifications should be considered only if specific gaps are identified.

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