

Review of Domestic and International Regulatory Approaches for Licensing Heat-Supply Light-Water SMRs

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1. Introduction

Interest is growing in the use of light-water small modular reactors (SMRs) for district heating and industrial process heat as part of efforts to decarbonize the industrial and heating sectors. Because heat-supply reactors may differ from conventional power reactors in their intended use, thermal output, operating conditions, and system configuration, the applicability of the existing regulatory framework needs to be examined. This study reviews publicly available regulatory information and heat-supply-related regulatory review experience in Finland, the United States, and Canada, and identifies key considerations for the licensing of heat-supply light-water SMRs in Korea.

2. Characteristics of Heat-Supply Light-Water SMRs

Finland's LDR-50, a representative light-water SMR dedicated to heat supply, is being developed as a 50 MWth district-heating reactor featuring low-temperature and low-pressure operation, natural circulation, and passive decay heat removal. Because it does not require a power conversion system and differs from a conventional power-producing PWR in operating conditions and system configuration, the applicability of existing safety requirements may need to be evaluated.

3. International Regulatory Approaches and Heat-Supply-Related Reviews

3.1. Finland

Finland's Nuclear Energy Act includes the production of electricity or heat within the purpose of a nuclear power plant; therefore, a reactor dedicated to heat supply is also subject to the existing nuclear regulatory framework. Detailed safety regulation is based on the relevant legislation and the STUK Regulations/YVL Guides. In 2024-2025, STUK conducted a preliminary safety assessment of the LDR-50. This was not a formal licensing review, but an early regulatory review intended to identify the applicability of regulatory requirements and major safety issues at an early stage of design. A Joint Early Review (JER) involving regulatory authorities from several countries was

subsequently conducted. The JER likewise did not constitute a common design approval, but was intended to jointly examine key issues and the potential use of prior regulatory review results.

3.2. United States

Commercial reactor licensing in the United States has traditionally been based primarily on 10 CFR Parts 50 and 52. In 2026, the U.S. Nuclear Regulatory Commission (NRC) established 10 CFR Part 53 as an additional optional licensing framework based on risk-informed, performance-based, and technology-inclusive principles. Part 53 is intended to provide a flexible framework applicable across reactor technologies, sizes, and commercial end uses. In addition, the NRC considered 'Industrial Facilities Using Nuclear-Generated Process Heat' as a policy issue for SMRs and non-light-water reactors, noting that co-location of a nuclear plant and an industrial facility using nuclear-generated process heat could raise both technical and regulatory jurisdiction issues. Pre-licensing interactions for the Next Generation Nuclear Plant (NGNP) also considered combined electricity production and industrial high-temperature heat applications.

3.3. Canada

Canada regulates reactor facilities under the Nuclear Safety and Control Act (NSCA), the Class I Nuclear Facilities Regulations, and the Canadian Nuclear Safety Commission (CNSC) REGDOC framework. REGDOC-1.1.5 provides for a graded approach that is commensurate with the novelty, complexity, and potential hazards of an SMR, as well as an alternative approach for demonstrating that the safety intent of an existing requirement is met. It also addresses pre-licensing activities such as Vendor Design Reviews (VDRs). As an actual heat-supply-related example, Global First Power's Micro Modular Reactor (MMR) was proposed to transfer process heat through molten salt to an adjacent plant for electricity and/or heat use, and underwent review for a Licence to Prepare Site and environmental assessment. CNSC states that related review activities have been paused since August 2024.

4. Regulatory Considerations for Application in Korea

A comparison of international cases with Korea's current regulatory framework indicates that licensing a heat-supply light-water SMR will require consideration of how the regulatory framework should accommodate its new end use and design characteristics.

First, the legal and regulatory status of a heat-supply reactor and the applicable licensing framework need to be examined. Korea's Nuclear Safety Act establishes licensing frameworks primarily for power reactors and for research or training reactors, but does not explicitly establish a separate licensing category for a reactor whose primary purpose is commercial heat production and supply. The relationship between reactor end use and the applicable licensing framework should therefore be examined not only for heat-only reactors but also for future cogeneration configurations that produce both heat and electricity.

Second, the applicability of existing safety requirements for power reactors needs to be evaluated. Because a heat-supply SMR is based on light-water reactor technology, much of the existing light-water reactor safety framework may be usable. However, differences in thermal output and operating conditions, simplified system configurations, and passive safety features may result in differences in how some detailed requirements should be applied. An approach is therefore needed that preserves the regulatory intent and safety functions of existing requirements while applying them in a manner commensurate with the design characteristics and risk.

Third, the safety interface and regulatory boundary between the reactor and the heat-supply system need to be examined. The NRC's policy review of nuclear-generated process heat similarly identified technical and regulatory jurisdiction issues associated with co-location of nuclear and industrial facilities. Relevant issues may include the effects of normal and abnormal conditions in the heat-demand system on reactor safety functions, prevention of radioactive material transfer to an external heat-supply network, and the scope of regulatory responsibility and jurisdiction between the nuclear facility and the external heat-user facility.

Fourth, the applicability of siting and emergency preparedness requirements should be examined in view of proximity to heat users. District heating and industrial process heat generally place a premium on geographic proximity to the heat demand because of heat-transfer efficiency and economics. The applicability of requirements developed primarily for conventional power reactors should therefore be assessed in light of reactor power, radioactive inventory, accident release characteristics, and passive safety features.

The above items are not regulatory issues formally established by the Korean regulatory authority at this stage; rather, they are areas for further examination identified through the comparative analysis in this study.

As the design becomes more mature, a requirement-by-requirement gap analysis should be performed to determine appropriate application methods and the need for alternative approaches or additional regulatory guidance.

5. Conclusion

The cases of Finland, the United States, and Canada show that regulatory mechanisms and practical review experience exist for accommodating heat-supply applications and new SMR characteristics within existing or additional licensing pathways. For Korea, the regulatory status and applicable licensing framework for a heat-supply reactor should first be clarified. The applicability of existing safety requirements, the regulatory boundary with the heat-supply system, and siting and emergency preparedness issues associated with proximity to heat users should then be examined in stages as the design matures.

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