Evaluation of NGNP Design Certification Boundaries

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1. Introduction

The Next Generation Nuclear Plant (NGNP) Project supports commercialization of the high temperature gas-cooled reactor (HTGR) technology. HTGR can be applied in many industrial applications as a substitute for burning fossil fuels, such as natural gas, in addition to producing electricity, which is the principal application of current light water reactors. Given that the HTGR configuration will be different than the current fleet of licensed reactors, there should be a clear understanding between the HTGR applicant and the regulatory body regarding the demarcation between those systems that are within the nuclear facility and under the regulatory jurisdiction and those that fall outside the scope of the regulation. To communicate the NGNP Project's position regarding this issue, NGNP has recently published a report [1]. This paper evaluates the concept proposed in the report and proposes how to establish the design scope in case HTGR licensing is applied in Korea.

2. Design Scope and Level for LWR

Standard design certification is a regulatory process valid under 10 CFR Part 52, a combined license (COL) regulatory framework of U.S. NRC. COL is generally known as one-step licensing process. Utility applies the standard design approval (SDA) and once they get the SDA, they do not need to apply for other licensing review. Performance and safety will be confirmed through ITAAC (inspections, tests, analyses, and acceptance criteria). On the other hand, Korea still adopts two-step licensing process which means utility should provide PSAR (preliminary safety assessment report) to get a construction permit and FSAR (final safety assessment report) to get an operation license.

Design level necessary for SDA under COL is well prescribed in SECY reports[2,3], while the design scope is described in the Regulatory Guide 1.206 in a general level [4]. We will briefly summarize the concepts in the following.

2.1 Level of Detail for LWR Design Certification

10 CFR 52.47 (a)(1) requires that an application for a design certification include a level of detail that would satisfy the regulatory requirements for technical information in an FSAR, except to the extent that particular requirements are technically irrelevant or site specific. Section 52.47(a)(2) addresses that the level of detail must permit NRC to reach a final conclusion on all safety questions associated with the design before certification. It also requires a level of detail in the application such that the application itself would contain sufficient information to permit the preparation of procurement and construction and installation specifications.

2.2 Design Scope for LWR Design Certification

10 CFR Part 52 is clear regarding the scope of an application for design certification stating that, with some exceptions for reactors of advanced design, "Any person may seek a standard design certification for an essentially complete nuclear power plant design…" An essentially complete design includes all structures, systems, and components which can affect safe operation of the plant except for site-specific elements such as the service water intake structure and the ultimate heat sink.

On the other hand, RG 1.206 specifies the information to be included in a COL application and the scope is depicted as Fig.1 below. It is generally understood that the design scope necessary for DC covers around 70% of the full design scope.

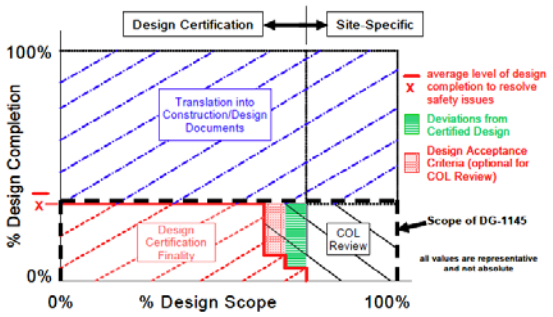

Fig. 1. Combined License Application Referencing a Certified Design

3. Evaluation of NGNP Design Scope

This section will summarize the design scope proposed by NGNP and then specify some safety characteristics of industrial process coupled to HTGR. Comparing the level of detail and the design scope summarized in section 2 could shed light on how to define the design scope for the design certification of HTGR.

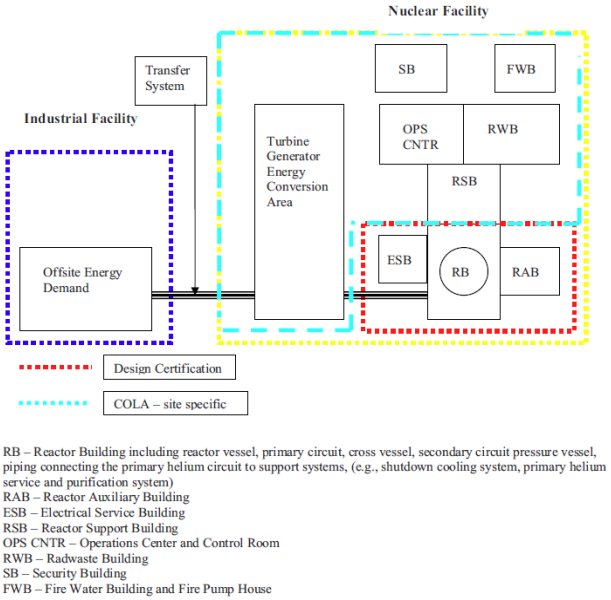

Fig. 2. Notional Regulatory Demarcation Boundaries [1]

3.1 Design Certification Boundaries of NGNP

The key point of this report is defining a boundary between the HTGR nuclear facility, under the regulatory jurisdiction of the NRC, and an end user facility that would fall outside the scope of the NRC, as well as defining the plant scope to be addressed in an HTGR DC. The conclusion is shown in the Fig.2 above. Industrial facility is not included in the DC boundary while the transfer system design and interfaces need to satisfy some high level design and interface requirements. One example of this requirement is "Nuclear facility plant system transients caused by industrial facility systems or the electrical transmission grid would be limited (in frequency and severity) and analyzed in the plant's safety analyses, similar to the way transmission grid disturbances are evaluated in existing light water reactors."

3.2 Safety Characteristics of Industrial Process

Feasibility of coupling an industrial process and a High Temperature Reactor (HTR) was studied by Baudriand et al. [5]. One principle is that the safety level of the nuclear plant shall not be lowered by the coupling. For this, a safety distance between the nuclear plant and the industrial site, and the limits for the occurrence frequencies of the abnormal events potentially induced by the process plant need to be established. The nuclear plant safety demonstration shall integrate the potential hazards induced by the coupled process in the standard category of event called "external events"

3.3 Evaluation of the NGNP DC Boundaries

As summarized in section 2.1, U.S. NRC requires detailed level to reach a final conclusion on all safety questions associated with the design. Also the safety impact caused by the industrial process needs to be assessed as external events. This could mean that the mechanical demarcation of boundaries based on whether they fall under the jurisdiction of regulation or not, as proposed by NGNP, does not fully satisfy the spirit of design level required for DC. We need a safety distance criteria and also the boundary needs to be defined according to the safety impacts of the industrial process.

4. Conclusions

Design level and scope for design certification of LWR was introduced. The DC boundaries proposed by NGNP together with the recent feasibility study of coupling the industrial process and the HTGR was explained. Evaluating the acceptability of the NGNP boundary, we conclude that the mechanical demarcation of boundaries based on the issue of regulatory jurisdiction is not the best way. Safety impact caused by industrial process needs to be considered in defining the DC boundaries of HTGR

REFERENCES

[1] INL/EXT-11-21605, NGNP Nuclear-Industrial Facility and Design Certification Boundaries, July 2011
[2] SECY-90-241, Level of Detail Required for Design Certification under Part 52, U.S. NRC, July 1990
[3] SECY-90-377, Requirements for Design Certification under 10 CFR Part 52, U.S. NRC, November 1990
[4] Regulatory Guide 1.206, Combined License Applications for Nuclear Power Plants (LWR edition), U.S. NRC, June 2007
[5] Olivier BAUDRAND et al., Feasibility study for the safety assessment of a High Temperature Reactor coupled with an industrial process, Proceedings of ICAPP 2011, May 2011