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Small Reactor Facilities – a Perspective on Licensing

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ABSTRACT – This extended abstract discusses a sample of the various issues that small reactor applicants or vendors may encounter in the lead-up to the submission of a construction licence application to the Canadian Nuclear Safety Commission.

1. Introduction

The Canadian Nuclear Safety Commission (CNSC), under the *Nuclear Safety and Control Act* (NSCA), has five stages of licences which reactor facilities progress through. In chronological order, these are a licence to prepare a site for a nuclear facility, a licence to construct, a licence to operate, a licence to decommission and a licence to abandon once all decommissioning activities are complete. The licensing process in Canada is independent of technology type or power level / size of the reactor facility. Regardless of the licence structure or stage of licence, the public and all stakeholders are involved throughout the entire process.

The licensing process is initiated with the licence to prepare site application which triggers an Environmental Assessment (under the *Canadian Environmental Assessment Act, 2012*). The review of the licence application and Environmental Assessment are generally done in parallel as a matter of efficiency since much of the site information is common to these two processes but assessed differently. The Canadian licensing process does not preclude an applicant from applying for licences in parallel, for example a licence to prepare site in parallel with a licence to construct, or even a licence to prepare site, construct and operate. This latter approach would require a proponent to be at a very advanced state of readiness to demonstrate that it meets all of the requirements applicable to those licences. For nuclear power plant facilities, the use of combined licences is more likely possible for a second or third of a kind facility. CNSC anticipates that proponents of smaller so-called Small Modular Reactor (SMR) facilities such as 'nuclear batteries' will use a combined licensing approach because of anticipated short construction and commissioning timelines.

Some SMR concepts envisage using multiple modules housed within a single reactor facility. CNSC has experience in licensing multiple unit facilities at Pickering, Bruce and Darlington nuclear generating stations. CNSC foresees that a facility with multiple modules would likely have a single licence that would cover all modules within the facility.

2. Safety Approach is Risk Informed

In Canada, all reactors are considered Class IA nuclear facilities under the NSCA and its regulations. The regulations themselves are written at a high level meaning that they can be applied regardless of size or facility end-use. Historically, the CNSC has recognized that potential risks posed by different nuclear facilities can vary depending on factors such as reactor core characteristics, facility end-use, etc. In 2008, CNSC documented its design and safety analysis requirements for nuclear power plants[1], but recognized that not all of those requirements were necessarily suitable as-written for smaller reactor facilities. Consequently, the Commission permitted CNSC staff to establish parallel design

[1] RD-337, *Design of New Nuclear Power Plants* [1] and RD-310, *Safety Analysis for Nuclear Power Plants* [2].

and safety analysis requirements[2] for reactor facilities below a threshold of approximately 200 MWth. CNSC uses this rough threshold to divide traditional NPPs from *Small Reactors;* however, it is important to recognize that the 200 MWth threshold should be treated as a guideline only. Some SMRs will have characteristics more in line with NPPs, while others more closely fit a *Small Reactor*. There is no "relaxation" of requirements for small reactors. In fact, the requirements for Small Reactors are very similar to those for NPPs, however they permit some additional flexibility in the use of the graded approach[3].

Risk Informed Safety approaches are not new in Canada. For example, the design of any nuclear facility must provide the fundamental safety functions during and following a postulated initiating event; controlling reactivity, cooling the reactor core and confining radioactive material. These safety functions are not gradable but the design extent and engineering rigor necessary to adequately ensure they are achieved will vary depending on reactor design. Proposals for use of the graded approach would be assessed on an individual basis from the safety case submitted. CNSC expects the applicant to demonstrate that their safety case is commensurate with the risks posed by the facility and the applicant will be expected to explain the bases for their use of graded approach.

3. The Advantage of Early Engagement with CNSC

CNSC recognizes that early engagement between an applicant and CNSC staff allows the applicant to discuss and resolve potentially troublesome licensing issues early. Early discussions also allow an applicant to confirm they understand CNSC requirements for the purposes of developing complete licensing submissions. Examples of such early engagement include:

- To establish a project-specific submission schedule so that CNSC can plan it's review approach.
- To obtain CNSC comment on the applicant's approach for developing their management system structure.
- To obtain CNSC feedback on long-lead item issues such as concurrence on:
    - Safety classifications;
    - Codes and standards to be used;
    - Code-effective date; and
    - Quality assurance requirements.

In order to maintain the regulator's role as an independent[4] reviewer of a proponent's safety case, the CNSC must never become part of the design process other than to clarify its requirements.

Where early applicant / CNSC engagement is expected to be significant, CNSC recommends that a Communications Protocol be established to prevent communication issues.

CNSC also encourages other early engagement activities such as the pre-licensing vendor design review process (CNSC / vendor discussions) and early public engagement.

4. Codes and Standards

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[2] RD-367, *Design of Small Reactor Facilities* [3] and RD-308, *Deterministic Safety Analysis for Small Reactor Facilities* [4].
[3] For example, as described in IAEA Safety Standard NS-R-4, *Safety of Research Reactors*, 2005
[4] As described in requirement 17 of IAEA GSR-Part 1 *Governmental, Legal and Regulatory Framework for Safety*

CNSC is anticipating that the majority of new reactor designs, including small reactors, will originate from outside Canada and, as such, would have been designed to the vendor country's codes and standards.

In recognition of this, a proponent in Canada may propose the use of alternative codes and standards provided that they can demonstrate an equivalent level of safety to Canadian codes and standards[5]. The proponent will need to show their analysis on the differences between the codes and standards and how they are addressing gaps. The code comparison work by the vendor is particularly important in situations where the design is a first-of-a-kind, or will utilize novel design features or engineering techniques. Where a reactor technology vendor chooses to undergo a pre-licensing vendor design review, this area is examined for all of the focus areas such that the vendor gets early feedback of potential fundamental barriers to licensing their technology in Canada.

CNSC also recognizes that, for some designs, existing codes and standards may not be applicable or codes and standards may not yet exist. Although CNSC will participate in the modification or development of necessary codes and standards, in Canada, it is industry's responsibility to lead these discussions whether in licensing or with the appropriate codes and standards bodies. For SSCs important to safety, for which there are no appropriate established codes or standards, an approach derived from existing codes or standards for similar SSCs with similar safety significance may be applied. The approach should include adequate tests and analysis to demonstrate that the SSCs will perform its safety functions to a level commensurate with its classification. Where adherence to existing codes and standards does not sufficiently reflect the safety importance of the SSC, then they must be supplemented or modified as necessary.

Safety classification requirements and methods vary from country to country. Because safety classification of SSCs is closely tied to codes and standards, the applicant is expected, during licensing, to demonstrate they understand the bases behind the safety classification methodology used for that design. By looking at the methodology behind safety classification, CNSC can confirm the licensee understands how classification levels are being used to ensure that the application of such things as engineering rigour, quality assurance, inspection and testing during design, construction, operation and maintenance is commensurate with the safety importance of the SSC in the overall plant's operation. CNSC staff is currently documenting its requirements and expectations in the area of safety classification; however, where a reactor technology vendor chooses to undergo a pre-licensing vendor design review, this area is examined as a specific focus areas such that the vendor gets early feedback.

5. Conclusion

The CNSC has, in place, a consistent and flexible licensing process that can be applied to all reactor facilities – regardless of the power level, application or size of the facility. Although CNSC continues to develop requirements and expectations for reactors of all sizes, the fundamental requirements and expectations are in place for those 'SMRs' that may be proposed for use in Canada.

6. References

[1] RD-337, *Design of Nuclear Power Plants*, CNSC, 2008.

[2] RD-310, *Safety Analysis for Nuclear Power Plants*, CNSC, 2008.

[3] RD-367, *Design of Small Reactor Facilities*, CNSC, 2011.

[4] RD-308, *Deterministic Safety Analysis for Small Reactor Facilities*, CNSC, 2011.

[5] Such as Canadian Standards Association (CSA) and American Society of Mechanical Engineers (ASME) codes and standards