Comments on CNSC Discussion Paper DIS-16-04

Small Modular Reactors: Regulatory Strategy, Approaches and Challenges

Introduction

In May 2016 the CNSC issued Discussion Paper DIS-16-04 "*Small Modular Reactors: Regulatory Strategy, Approaches and Challenges*" for public/industry comment. The document included a number of questions aimed at determining whether or not DIS-16-04 required clarification or modification in order to provide clear, unambiguous guidance to small reactor[1] stakeholders on how it intends to regulate small reactors in Canada.

The Canadian Nuclear Association (CNA) led an effort to collect and integrate comments from the industry. On 8 September 2016 a meeting was held to reach agreement on a unified set of industry comments that CNA would then submit to the CNSC on behalf of the industry. The participants at that meeting reviewed industry comments on DIS-16-04 section by section and were successful in reaching consensus on a consolidated set of comments to be submitted to the CNSC. It was also successful in arriving at a set of major themes that reflected industry's view on the SMR Discussion Paper.

Amec Foster Wheeler generally agrees with the comments and major themes. Additional comments and observations for consideration by the CNSC are provided below. These also include some relatively minor editorial comments intended for additional clarification.

General Comments and Observations

Amec Foster Wheeler believes that the CNSC has done an excellent job of summarizing the status of small reactors in Canada and of describing how they fit within the current regulatory framework. We also agree with the major themes developed at the 8 September 2016 industry meeting, which were:

1. Discussions paper DIS-16-04 was well written and allowed industry to provide effective input to the CNSC.
2. Industry is in support of the application of the graded approach to all the elements in DIS-16-04.
3. We do not see a need for significant changes to the regulatory framework to support the eventual deployment of SMRs within Canada.
4. It is beneficial to streamline the reactor licencing process in Canada to take into account the intent of "repeatability" of SMR units.
5. Collectively, industry does not see any insurmountable roadblocks to licensing SMRs in Canada under the existing regulatory framework.

[1] The terms small reactor and small modular reactor (SMR) are used interchangeably throughout this document.

Executive Summary

1. Suggest rewording the sentence "However, proposals must demonstrate, with suitable information, that they are equivalent to or exceed regulatory requirements." Alternative wording may include: "Proponents must demonstrate that their proposed approach is equivalent to or exceeds regulatory requirements".

Section 1: Introduction

2. The same comment as above applies.
3. Although it has become common practice to refer to SMRs, the Canadian regulatory regime is based on 'small reactors' rather than 'SMRs'. (SMR is considered to be primarily a marketing terminology.) While this becomes increasingly clear later in the Discussion Paper it would be worthwhile clarifying this distinction in this section.
4. The parenthetical phrase "(which include SMRs and advanced reactors)" in the first sentence of the second paragraph could be taken to suggest that the CNSC considers SMRs and advanced reactors to be different. We do not believe this was the intent and suggest that it be clarified since there are 'advanced reactors' that are neither small nor modular and 'SMRs' that are 'advanced reactors'.
5. In concluding this section with respect to key areas in which its regulatory framework might be challenged by novel features of the new generation of advanced SMRs, the CNSC has asked "…whether different requirements or guidance are needed to further support those already existing". It is our view that different requirements or guidance are not required as long as proponents of these designs have a good understanding of the existing requirements and how to interpret them in the context of their proposed designs.

Section 2.1: Introduction

6. There are other topics that could be added to the list of those that are important to the discussion, but they are not needed in order to make the point of this introduction.

Section 2.2: Technical information, including research and development activities used to support a safety case

7. The footnote on page 6 states that SMRs are being developed to make rapid power adjustments and that "This rapid response is necessary for very small grids, grids with rapid load changes, and those serviced by intermittent supply sources." Stating that this rapid response is necessary presupposes an operational requirement imposed on SMR designs that might be achieved in other ways. We would prefer to see this wording softened to say that rapid response may be required depending on the intended use of the SMR within the electrical grid.

Section 2.3: Licensing process for multiple module facilities on a single site

8. CNSC states that they are "seeking information on facility deployment strategies being considered by developers" and that they "will use this information for future more-detailed workshops to discuss regulatory implication of different deployment approaches." Amec Foster Wheeler recognizes that the various strategies being considered, particularly those that involve deployment from one province to another, raise a number of complex legal and regulatory challenges that need to be addressed. We welcome the emphasis CNSC has been putting on a Canadian deployment study and believe that future more-detailed workshops to discuss the implication of these different deployment approaches would be beneficial. When these studies are complete, DIS-16-04 would benefit from a revision to incorporate any insights.

Section 2.4: Licensing approach for a new demonstration reactor

9. CNSC notes that "Many companies have asked if the CNSC has a simplified licensing approach for demonstration facilities." They have addressed this by stating that "a demonstration reactor facility is a Class 1A nuclear facility and therefore subject to the same regulations as a full-scale nuclear power plant." We agree with this statement.

10. Most SMR developers are considering siting their demonstration reactor on an already-licensed site. Although that will not simplify the overall process by eliminating the need for certain elements, the implementation of some specific steps in that process could be simplified. That should be acknowledged either here or in Section-2.5, since the environmental process is one of the steps that could be simplified.

Section 2.5: Licensing process and environmental assessments for fleets of small modular reactors

11. The first two paragraphs of this section address the licensing process for fleets of small modular reactors. The remaining paragraphs discuss the environmental process, again for fleets of SMRs. While both have 'fleets of small modular reactors' in common, the actual discussions in each of these two parts have little in common. It would help clarify the discussions if this section were split into two separate sections.

Section 2.6: Management system considerations: Licensees of activities involving small modular reactors

12. This section addresses management system considerations which are applicable to all nuclear power plants, not just SMRs, and states that they are "the processes necessary to ensure safe conduct of licensed activities". This highlights the fact that in Canada it is the activities of siting, constructing, operating, etc. that are licensed, not the reactor design itself. This is an important distinction between the Canadian regulatory system and that of many other countries, and one that must be understood by SMR developers. This may not be emphasized sufficiently in previous sections and could be discussed more fully in this section.

Subsection 2.6.1: Management system: Minimum complement in small modular reactor facilities

13. Minimum staff complement is a topic that should be discussed in its own right, not just as a subsection of management considerations. It is one of the key factors that could have an adverse impact on the success of a new SMR project. SMR developers need to be able to take advantage of the novelties in their design and the application of the graded approach in order to optimize their minimum staff complement.

14. Minimum staff complement is also closely related to safety, security, safeguards, and emergency planning. They require an integrated assessment in order to have the minimum adverse impact on an SMR project. More detail is included in comment 15 and others below.

Section 2.7: Safeguards implementation and verification

15. Safeguards, security, minimum staff complement and the emergency planning zone are closely related topics that require an integrated assessment in order to have the minimum adverse impact on an SMR project. The assessment must take into account the novelties in the design, the graded approach, and a sophisticated understanding of the Canadian licensing regime and how it is applied in order to achieve a viable SMR project.

Section 2.8: Deterministic/probabilistic safety analyses

16. In the wrap-up to this section the CNSC asked, among other things, "Do the existing requirements permit the establishment of a suitable level of probabilistic safety analysis for different novel designs?" and "Does enough information currently exist to apply probabilistic safety analysis to novel designs?". It is our view that existing requirements are adequate and that there is likely to be sufficient information available for a preliminary,

indicative probabilistic safety analysis (PSA). At an early stage where sufficient data may not be available for a more comprehensive PSA this could necessitate that a clear set of assumptions be specified for the analyses. A management program aimed at validating or updating these assumptions as more data becomes available will then be required.

Section 2.9: Defence in depth and mitigation of accidents

17. The defense-in-depth level descriptions are those we are familiar with for currently operating water-cooled reactors in Canada. However, they may not be applicable for some of the advanced, non-water-cooled SMRs. This section should clarify the distinction and acknowledge the fact that more appropriate levels may need to be, and can be, proposed by the reactor designer.

Section 2.10: Emergency planning zones

18. As noted in comment 15, safety, security, safeguards, minimum staff complement and emergency planning zone are closely related topics that require an integrated assessment in order to have the minimum adverse impact on an SMR project. The assessment must take into account the novelties in the design, the graded approach, and a sophisticated understanding of the Canadian licensing regime and how it is applied. This requires a more extensive assessment than suggested by the first sentence of this section which states only that "Technology developers are seeking ways to reduce emergency planning zones (EPZ) size, taking into account technology improvements."

Section 2.11: Transportable reactor concepts

19. Paragraph 3 is in a larger font than the other paragraphs (12 point rather than 11 point). It should be consistent.

20. The fourth paragraph of this section states "The approach for licensing all activities concerning the deployment of transportable reactor concepts and understanding how requirements would be met depends on the deployment scenario proposed and the nature of the activities in each phase of deployment." In the final questions the CNSC says it "is seeking information about deployment scenarios for further discussion." We believe that an industry-wide Canadian deployments study is critical and have been involved in preliminary work on such a study. We will continue to work with other stakeholders to complete this study.

Section 2.13: Human/machine interfaces in facility operation

21. A Human Factors Engineering (HFE) team should be able to assess alternative approaches to human factors. We do not think additional clarification is required.

Section 2.14: The impact of new technologies on human performance

22. The CNSC states that "Human performance may be described as the outcomes of human behaviours, functions and actions when carrying out work tasks", that "Human performance is a key contributor to the safety of nuclear facilities" and that "it is necessary to control factors that can have a negative effect on humans doing work." One such negative factor that is not typically assessed but is nevertheless potentially significant is a person's unwillingness to enter a highly hazardous workplace or take on a highly hazardous assignment. This is not known to have been the case with nuclear accidents (and in many cases quite the opposite has been true). Nevertheless, it is a phenomenon that has been observed in other emergencies, such as pandemic scares, for example, where a small percentage of workers may refuse to report to work, either because they fear becoming ill or because they are caring for afflicted family members. We believe this should be taken into consideration to some extent.

Section 2.16: Site security provisions

23. As noted in comment 15, safety, security, safeguards, minimum staff complement and emergency planning zone are closely related topics that require an integrated assessment in order to have the minimum adverse impact on an SMR project while providing the appropriate level of safety and security. The CNSC states that "Developers of SMR technologies are seeking alternative approaches to security, such as security by design, in order to reduce the need for security personnel." It may be worth noting that more sophisticated assessment processes could be used to reduce the operational burden of security forces (i.e., optimization of security resources). For example, Amec Foster Wheeler has developed a Probabilistic Security Model approach that is intended to maximize the safety and security of the plant while minimizing the significant costs associated with security forces[2]. It may be worthwhile for CNSC to clarify in one or more sections that that these are interrelated requirements and should be treated as such.

Section 2.18: Subsurface civil structures important to safety

24. The topic of "subsurface civil structures important to safety", particularly for remote norther regions, is one in which considerable experience exists outside the nuclear industry. While we recognize that the proponent of an SMR facility is responsible for describing the external experience they intend to use, it would be helpful for the CNSC to provide further guidance in this regard.

[2] S.K. Donnelly & S.B. Harvey, *Applications of Nuclear Safety Probabilistic Risk Assessment to Nuclear Security for Optimized Risk Mitigation*, 36th Annual Conference of the Canadian Nuclear Society, June 2016.