SMALL MODULAR REACTORS –UPDATE ON THE CNSC'S SMR DISCUSSION PAPER THE 4TH INTERNATIONAL TOPICAL MEETING ON SMALL REACTORS (ITMSR-4)

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ABSTRACT – To keep current on technology trends and regulatory implications, many nuclear regulators, including the CNSC, have been reviewing the application of novel features in more traditional, and larger, NPP designs. SMRs, however, represent novel technologies that aim to achieve greater efficiencies and reduced operational costs. One of the key questions that nuclear regulators – including the CNSC – must address with vendors and other stakeholders is what are the regulatory and licensing implications presented by SMRs? If a proponent decides to deploy such technologies in Canada, what are some of the key regulatory issues that need to be resolved in advance to meet Canadian licensing requirements?

Over the past several years, many technology developers have expressed interest in the construction and operation of SMRs in Canada. Consequently, the CNSC has been looking into the nuclear regulatory and licensing implications challenges for SMR-related activities. The CNSC has met with technology developers and conducted outreach with the public and academic institutions at conferencessuch as this conference.

Based in part on these interactions, the CNSC was able to confirm that existing regulatory requirements for nuclear power plants remain valid and useful. It was also determined that the CNSC should examine the level of applicability of existing nuclear regulatory requirements and guidance to the innovative approaches of SMRs.

As a result of the CNSC's examination, a discussion paper DIS-16-04, *Small Modular Reactors: Regulatory Strategy, Approaches and Challenges*was published on May 31, 2016 and is open for comments until September 28, 2016. The discussion paper provides an overview of potential regulatory issues associated with SMRs and how they could be addressed. In summary, the paper explained:

- issues at a high level, along with a short description of specific items to be addressed in future work
- how the CNSC plans to address these issues using existing regulatory tools and processes
- the implications of the innovative approaches being considered by SMR proponents that need to be examined to a greater degree to confirm if additional supporting regulatory requirements or guidance are needed

Most small modular reactor (SMR) concepts, although based on technological work and operating experience from past and existing plants, employ a number of novel approaches simultaneously.

Novel approaches can affect the certainty of how the plant will perform under not only normal operation but also under accident conditions, in which predictability is paramount to safety.
In addition to addressing the technical challenges of designing an SMR, an SMR proponent also needs to ensure that the design meets the CNSC's regulatory requirements.
This section examines some key areas where novel approaches may present uncertainties, and where information from the public and interested stakeholders would help inform regulatory policy.
The following list of topics was developed based on approximately five years ofinteraction with SMR vendors, utilities, government agencies and other interested stakeholders who have stated that these are important to the discussion. The topics are:

- technical information, including research and development activities used to support a safetycase
- licensing process for multiple module facilities on a single site
- licensing approach for a new demonstration reactor
- licensing process and environmental assessments for fleets of SMRs
- management system considerations
- licensees of activities involving SMRs
- safeguards verification
- deterministic and probabilistic safety analyses
- defence-in-depth and mitigation of accidents
- emergency planning zones
- transportable reactor concepts
- increased use of automation for plant operation and maintenance
- human/machine interfaces in facility operation
- impact of new technologies on human performance
- financial guarantees for operational continuity
- site security provisions
- waste management and decommissioning
- subsurface civil structures important to safety

The discussion paper drew 435 comments from the following:

- Ontario Ministry of Energy
- SNC – Lavalin
- Terrestrial Energy
- StarCore Nuclear
- Moltex Energy
- Bruce Power
- Ontario Power Group
- Canadian Nuclear Laboratories
- Canadian Nuclear Association
- Candesco
- Hatch Consulting
- Amec Foster Wheeler
- Mr. Lucas Forget

At a very high level, stakeholders commented that " …*the discussion paper was found to be well written and thus allowed industry to provide effective input during the review. The major themes of the consolidated comments are:*
1. Industry supports the application of a graded approach to all elements in the discussion paper.
2. There is no need for significant changes to the regulatory framework.
3. The licensing process should be streamlined to take into account production of repeat SMR units.
4. There are no insurmountable roadblocks to licensing SMR units in Canada under the existing regulatory framework. "

CNSC staff acknowledges and recognizes that additional discussions at the working level are necessary to further reinforce how application of the graded approach is possible in the development of a safety case for SMR projects. This comment was not unexpected given the variety of technological concepts being developed and the conditions under which they would be constructed and operated.

CNSC recognizes that many of the novel approaches and design concepts being proposed for SMRs (as well as larger reactors) have the potential to enhance safety in the construction and operation of nuclear facilities. However, an applicant for a licence must demonstrate to the Commission that the safety claims of approaches/design concepts are sufficiently proven via relevant and credible:
- operating experience
- combinations of technical and R&D investigation necessary to support the scientific claims.

Because each SMR concept is different, these demonstrations need to be performed and considered on a case by case basis.

The range of SMR designs and energies managed vary considerably. However the hazards presented by all of them are consistent with Class 1A nuclear facilities which address requirements for all reactor facilities. There is no clear evidence at this point in time that SMRs represent a separate class from the facilities currently regulated under Class 1 Facilities Regulations.

CNSC remains open to discussing industry proposals on alternative approaches to licensing that continue to respect the principles laid out in REGDOC 3.5.1 Licensing Process for Nuclear Power Plants and Mines and Mills.The current EA and licensing process can already be applied to projects that will consider "expandable facilities". For example, the EA can be completed for a project that considers a maximum number of units for the site even if installation of some units will be deferred to match capacity growth projections. Licenses can be developed to encompass ongoing construction, commissioning and operation within the same facility to reflect expansion until all modules have been added. However, once the maximum capacity considered in the EA has been reached, further module additions would then trigger a new EA for the further expansion.

CNSC staff is considering future workshops on the application of the graded approach by applicants. Included in these discussions will be topics such as:
- Reinforcement of Defence in Depth principles

- The role of regulatory guidance in articulating grading in particular areas without compromising safety
- The role of supporting information in demonstrating that safety and control measures being proposed are adequate to meet requirements
- Application of conservative approaches where significant uncertainties exist in safety analysis
- An overview of the CNSC's Conduct of Technical Assessment Process in the technical assessment process of the CNSC

The presentation made at the CNS conference will highlight the feedback received from various stakeholders on DIS-16-04 and outline how the CNSC will use the feedback received to bring greater clarity to its regulatory framework for SMRs.