



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Canada

Update on CNSC's Readiness to Regulate Projects Proposing the Use of Small Modular Reactors (SMR)

K. Lee and M. de Vos
CNSC SMR Working Group

Safety and Licensing of SMRs
Canadian Nuclear Society
**3rd International Technical Meeting on Small
Reactors**

Ottawa, ON
November 5-7, 2014

nuclearsafety.gc.ca





A Review...

Safety: The CNSC's Role Versus the Licensee's Role



The CNSC's role is regulatory oversight by:

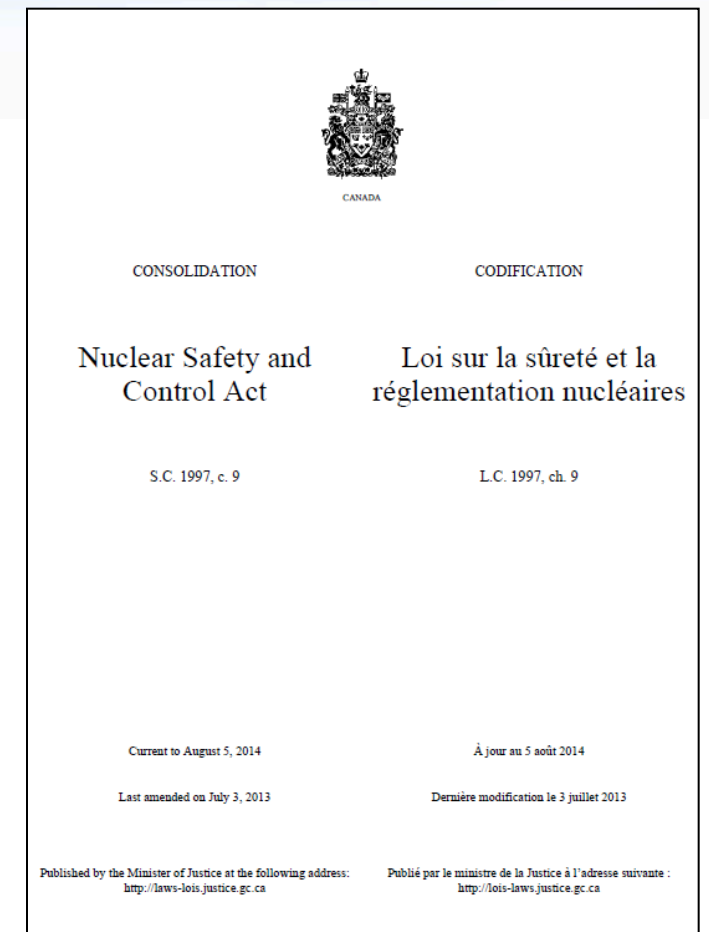
- ☑ Ensuring regulatory requirements are clear
- ☑ Ensuring a balanced, efficient and transparent licensing process
- ☑ Confirming the licensee is meeting regulatory requirements and applying enforcement measures as necessary



Nuclear Safety and Control Act NSCA

- § 3. The purpose of this Act is to provide for
(a) the limitation, to a reasonable level and in a manner that is consistent with Canada's international obligations, of the risks to national security, the health and safety of persons and the environment that are associated with the development, production and use of nuclear energy and the production, possession and use of nuclear substances, pre-scribed equipment and prescribed information...

The Commission makes informed, science-based decisions on the mitigation of risk to a reasonable level





Decisions Made by the Commission Take Into Consideration:

- Analyses and recommendations from CNSC staff, based on their assessment of both licensee and stakeholder submissions to the Commission
- Best available information, arising from regulatory research or third-party credible research
- Public input, through the formal hearing process

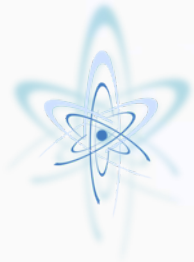
Understanding risks and mitigating those risks plays a significant role in the decision-making process



The Licensee Is Responsible for Safety and Is Held Accountable Through Their Licence

Section 24(4) of the Nuclear Safety and Control Act (NSCA)

- No licence shall be issued, renewed, amended or replaced — and no authorization to transfer one given — unless, in the opinion of the Commission, the applicant:
 - a) is qualified to carry on the activity that the licence will authorize the licensee to carry on
 - b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed



How Does the Licensee Accomplish This?

- Based on information contained in regulatory documents and applicable codes and standards, the applicant is expected to demonstrate how they will meet the requirements under the Nuclear Safety and Control Act and associated regulations.
 - This is done through an application for a licence to the Commission
- An application (and associated submissions) is expected to be risk-informed, and be supported by scientific facts and suitable information.

The application forms a major part of the Licensing Basis



Update on CNSC's Readiness Preparations for Potential Deployment of New Technologies (Including SMRs)



We have a better understanding of what the term “SMR” represents

- The discussion is really less about facility size and more about understanding implications of technological differences (i.e., novelties) such as:
 - New reactor architectures and arrangements
 - Different fuels and cooling methodologies
 - Different manufacturing and construction approaches
 - Use of systems to further enhance operation and maintenance
 - Where they might be sited and what they might be used for

Each area raises safety questions whose answers need to be supported by R&D, proven design methodologies, etc. when used to support a licensing proposal

Understanding what a “SMR” represents has shaped our readiness preparations

- We recognize that:
 - Requirements should be based on well-understood nuclear safety principles that are technology neutral
 - Guidance should speak to a graded application of those requirements under different circumstances and risk scenarios (i.e. use of risk-informed insights)
 - Both of the above need to reinforce the need for supporting evidence based on sound science and engineering practices

Safety will not be compromised



Activities and facilities must be demonstrably safe

Passively Safe?

Naturally Safe?

Intrinsically Safe?

Inherently Safe?

Gen 3++

Gen 4

Safer than...



Characteristics of Suitable Supporting Information

- Facts and data derived through validated and quality assured (i.e., traceable and repeatable) scientific and engineering processes, such as:
 - experimental or field-derived data
 - OPEX
 - computer modelling
- Uncertainties have been characterized and accounted for
- Information has been demonstrated to be relevant to the specific proposal

The more complex the risk characteristics, the greater the burden of evidence needed to support a proposal

CNSC's Regulations: Suitable for licensing activities using new technologies

- Licensing process and regulations are risk-informed and independent of reactor size or technology
- Currently, CNSC is conducting a periodic review of all of its regulations
 - Discussion Paper on this subject will be published shortly
 - Opportunity for the public to input their views on the regulations and whether/how they should change



Requirements that support the Regulations: “Shalls”

- In CNSC’s regulatory documents (REGDOCs) we are ensuring principles and their rationales are clear and, where possible, technology neutral and size independent. Examples where this has been done include:
 - REGDOC 2.4.1: *Deterministic Safety Analysis* (published)
 - REGDOC 2.5.3: *Design Requirements for Small Reactors* (under development – revision of RD-367) – twin of REGDOC 2.5.2 *Design Requirements for Nuclear Power Plants* (published)
- In codes and standards, same principles apply when choosing them for use in licensing, for example:
 - CSA N286-12 - *Management system requirements for nuclear facilities*



Guidance that supports Requirements (Shoulds)

- Being co-located with requirements in REGDOCs for ease of use
- Guidance may contain:
 - Rationale for the requirement
 - Practical guidance and suggestions to licensees and applicants on how to meet the CNSC's regulatory requirements (including information to promote best practices based on operational experience)
 - Licensees are expected to review and consider this guidance; if they choose not to follow it, they should explain how their selected approach still meets regulatory requirements.
 - Licence Application Guides (LAGs)- suggest application format and submission information and may contain relevant forms for applying for licenses or reporting information to the Commission
 - Information that discusses use of risk informed approaches (grading)



Use of “Graded Approach”

- The graded approach is a method in which the stringency of the design measures and analyses applied are commensurate with the level of risk posed by the reactor facility
- Factors to be considered include:
 - reactor power, reactor safety characteristics, fuel design, source term
 - amount and enrichment of fissile and fissionable material
 - utilization of the reactor
 - presence of high-energy sources and other radioactive and hazardous sources
 - safety design features
 - siting, proximity to populated areas

Guidance in REGDOCS being written to help with interpretation of requirements



Ongoing Efforts of the CNSC SMR Working Group

- Group was formed to research and anticipate issues around deployment of SMRs in Canada:
 - Multidisciplinary group representing management systems, safety analysis, policy analysis, licensing, technical issues and environmental assessment
 - Categorizing topics against the CNSC Safety and Control Areas framework
 - Goals:
 - understand what the issues are, who they affect, and whether, how and when they might need to be addressed
 - Prioritize and plan future work
 - Feed information into REGDOC development
 - Prepare to engage with industry, the public, and government stakeholders to answer questions

Explained in detail in our paper submitted to the CNS



Considerations organized into 3 broad groups:

First Group - Issue not likely a problem	Existing requirements and guidance already address the issue
Second Group - Issue requires some clarification (Short to medium lead time to resolve)	Clarification may be needed around application of the graded approach or the basis of the requirements needs to be more clearly expressed These we will likely address via REGDOC and standards updates For now, can be addressed in pre-licensing engagement discussions
Third Group - Issue requires significant regulatory analysis to understand potential risks and mitigation approaches Long lead time to resolve Challenges: <ul style="list-style-type: none">• We are not sure if or when the issue might be proposed in an application• May be technology dependent	CNSC is expecting industry to initiate the discussion with fairly detailed proposals - Public acceptance will be left to industry to address. CNSC staff will consider these proposals in developing regulatory positions based on science and engineering practices Public consultations, through processes such as CNSC Discussion Papers, will help to further establish regulatory positions prior to developing or modifying requirements and guidance Issues may also benefit from international discussion through regulatory cooperative arrangements



Examples of Third Group Issues

Third Group Issue	Comment
Codes and Standards for non-water cooled Technologies	In some cases, codes and standards may already exist for materials that come in contact with alternative coolants (from conventional industrial sectors) but they need to be reviewed and amended as needed to take into account nuclear applications.
Emergency Planning Considerations for Remote Regions	Defence –in-Depth needs to address this. Alternative approaches may be used and applicable provinces / territories need to be engaged in the conversation.
Unattended operation (autonomous facilities with remote intervention)	Although the concept of a fully automated, remotely monitored facility is technologically feasible the nuclear safety implications of this are not clear. It should be recognized, however, that precedent does exist for licensed unattended SLOWPOKE research reactor facilities based on their inherent core characteristics.
Handling and long term storage of irradiated fuel	Fuels from different SMR facilities will have different characteristics and enrichment levels. The long term implications on handling and storage in Canada need to be addressed.
Transport of fuelled reactor vessels	Whether transported with fresh fuel or irradiated fuel, the transport of a fuelled reactor core presents technical and regulatory challenges across a large number of technical areas ranging from safety analysis to materials sciences.



In Conclusion...

- CNSC 's regulatory framework is robust, flexible and technology neutral:
 - We are committed to setting the right level of requirements and guidance to enable flexibility without compromising safety
 - Where those requirements and guidance do not yet exist, we can develop positions informed by engineering judgement and scientific data
- Applicant / licensee needs to be prepared to demonstrate their proposals will meet or exceed requirements
- To help define and resolve issues, active and more public involvement on the part of non-governmental stakeholders is needed



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Canada

We Will Never
Compromise Safety...

... It's In Our DNA!

nuclearsafety.gc.ca

