September 28, 2016

To: Canadian Nuclear Safety Commission
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Canadian Nuclear Safety Commission
Public Consultation on Discussion Paper DIS-16-04, Small Modular Reactors: Regulatory Strategy, Approaches and Challenges

Comments on SMR Regulation in Canada

1. General Remarks

Hatch commends the Canadian Nuclear Safety Commission on compiling the very comprehensive Discussion Paper DIS-16-04 for public consultation. The paper accurately portrays the current state of development and challenges faced by the industry as well as the regulatory authorities. It is Hatch's opinion that the CNSC is well prepared to regulate the emerging Small Modular Reactor (SMR) industry to protect the safety of the Canadian public and environment.

Our comments and discussions on the SMR regulatory framework mostly focus on how the regulatory approval processes can be applied differently to a sub-class of SMRs, more specifically, to very small nuclear reactors being developed to provide power and heat to remote Canadian locations. We believe this industry is facing a unique set of development constraints.

Therefore, the general tone of Hatch's comments is to propose different ways of applying regulatory requirements to the licensing of very small nuclear reactors without relaxing the requirements that will give the industry a chance to evolve beyond the research and development stage.

2. Definition/Classification of SMRs

Currently, there is no universally accepted definition of an SMR. One widely used definition is that an SMR is a nuclear power reactor with less than 300 MW of electrical output. This is a broad definition that can cause confusion when regulatory discussions and public communications are held. The current regulation classifies an SMR as a Class 1A nuclear facility that also includes a broad range of nuclear power systems.

While it is understood that the further categorization of nuclear power reactors was not necessary in the past, it may be required for the new generation of nuclear power technologies being proposed in Canada. Hatch recommends that the CNSC provides an official definition of an SMR from a Canadian regulatory context or accepts a suitable definition proposed by the industry.

Currently, there two classes of SMRs being proposed for development in Canada and they can be categorized based on their intended applications. These classes are as follows:

- Utility-Scale Small Modular Reactors (USMRs): The first class of SMRs are those being developed for application in a conventional power market. These reactors are intended to compete with other mass power generation sources.
- Very Small Modular Reactors (VSMRs): The second class of SMRs are those being developed as primary energy sources to directly supply power or heat to microgrid systems or industrial facilities in remote areas. These reactors are usually much smaller than the USMRs and are being developed almost exclusively as diesel generator alternatives.

The USMRs share similar economics as large, conventional power plants. More specifically, these plants will generate large quantities of electricity over a long project lifetime and their initial technology development costs and regulatory costs are a relatively small portion of their total project costs. The VSMRs, on the other hand, are being developed with a different economic model. Their initial technology development costs can be only recovered after a fleet of reactors are deployed, and their regulatory costs can be a significant portion of their total project costs.

Hatch sees very little or no value in defining USMRs as a separate category of nuclear facilities in the regulatory context. These reactors are currently classified as SMRs because each reactor module is under 300 MWe, although in reality they are essentially smaller versions of a traditional nuclear power plants. Therefore, the licensing process of these power plants should not be different from that of a CANDU power plant. In contrast, VSMRs should be defined as a separate class of nuclear facilities in the Canadian regulatory context. Since some VSMR developers are proposing unprecedented technology and business practices, it is Hatch's observation that these developers have been causing most of the need for a SMR regulatory process review in Canada.

In Hatch's opinion, one possible definition of a VSMR is that it is 'a nuclear power system of standardized design that is intended to provide thermal and/or electrical energy to a captive market customer in lieu of diesel generators or other small facility-dedicated energy sources'.

3. SMR Licensing Approaches

While the current regulatory approaches and requirements are adequate for the purpose of safety assurance of class 1A nuclear facilities including VSMRs, they present significant regulatory uncertainties and investment risks for the proponents of VSMR development in Canada. A shift from a back-end loaded regulatory approach to a front-end loaded approach with regulatory review gates would be desirable for VSMR regulation.

3.1 Industry challenges

The current regulatory approaches are heavily back-end loaded from an emerging industry perspective, meaning that licensing reviews can only start after the proponents are 'ready'. The proponents must expend significant resources to complete the technology development, site selection and assessments, stakeholder engagements and organizational development before they can start a licensing application, all in absence of regulatory approval certainties.

While past nuclear technology developments in Canada were led by government organizations, the present VSMR industry includes companies with funding from private investors such as venture capital funds. These investments typically start with a small initial funding and increase in subsequent investment rounds as various risks are gradually reduced or eliminated. With the current regulatory approaches for a class 1A facility, the opportunity for a proponent to reduce the regulatory approval uncertainties is only available after significant upfront activities are completed, forcing proponents to seek a large initial funding with a high risk premium. Therefore, it is desirable in the VSMR regulatory approach to have a mechanism for providing gradually increasing regulatory certainties by front-end loading some portion of licensing activities.

The industry's need for a de-risking mechanism is demonstrated by the recent popularity of the Pre-Licensing Review of a Vendor's Reactor Design (VDR) application by VSMR developers. The developers are essentially using the VDR process as an investor reassurance tool; a positive review from CNSC will enable the applicants to secure additional funding from their investors.

3.2 Front-End Loaded Licensing Approach

While VDR serves as a tool for VSMR developers to engage the CNSC during the technology development stages and receive regulatory feedback, a similar tool is not available for a potential VSMR licensee prior to site selection. It would be essential for the VSMR industry to have a mechanism to confirm gradually increasing regulatory approval certainty prior to the site selection.

Hatch's proposition is not a relaxation of the current licensing requirements, but rather an extension of the precedent-based licensing approach already practiced by the CNSC. When a new license application for a facility is reviewed that is similar to an existing licensed facility, it has been understood that CNSC will focus on the differences between the new proposed license application and the existing one. Similarly, it has been communicated by the CNSC that for Nth-of-a-kind SMR applications using standard designs, the CNSC will be focusing on the differences between the Nth and (N-1)th facility assuming that the (N-1)th facility would have been already licensed. By extension of this practice, Hatch proposes that a generic, non-site specific licensing review is performed for VSMRs prior to a site selection, and only the differences are examined when a site specific application is submitted. This approach will allow the VSMR proponents to realize increased level of regulatory approval certainty earlier in the project lifecycle.

3.2.1 Generic License Application

In order to use the precedent-based licensing approach and to front-end load some regulatory activities in the project lifecycle, an applicant will need to define the reference

project based on enveloping parameters. The regulatory review can be performed based on the reference project resulting in a provisional license. It is envisioned that a few rounds of provisional licenses can be issued to a VSMR license applicant as the project is further refined.

3.2.2 Provisional Licenses

A provisional license is a license with conditions that need to be cleared before regular licenses are issued. The attached conditions could include site-specific requirements, technology maturity and organizational maturity. The provisional license is not a license that allows a proponent to prepare, construct or operate a nuclear facility, but a regulatory assurance document indicating that the applicants meet certain regulatory requirements based on the current project definition, and only the license conditions and project differences will be assessed when the regular license application is submitted for a specific site.

3.2.3 Class Environmental Assessment

Prior to selecting specific sites, it would be important for VSMR licensing to have a means to perform an environmental assessment based on enveloping parameters and receive regulatory feedback. At the time of the site-specific license application, it will need to be verified that the site-specific environmental conditions are within the enveloping parameters set in the class Environmental Assessment or that the impact of any non-compliant conditions will need to be reconciled. Such an approach would allow a potential VSMR licensee to reduce the project duration and in some cases to select project sites more effectively (i.e., allows a licensee to avoid certain geographical locations before spending resources).

4. Specific Comments on Current Regulatory Documents

In addition to the general comments on the VSMR regulatory approach, Hatch has two specific comments on the current regulatory documents.

4.1 Staff Complement

In regulatory guide document, *G-323, Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement*, the minimum staff complement is defined as ‘The minimum number of qualified workers who must be **present at all times** to ensure the safe operation of the nuclear facility and to ensure adequate emergency response capability.’

This definition does not allow the possibility of proposing a highly autonomous plant with plans to make staff available on site within a certain time frame to ensure the safe operation of the nuclear facility and to ensure an adequate emergency response capability. Hatch proposes that this definition is changed to ‘The minimum number of qualified workers who must be **available at all times** to ensure the safe operation of the nuclear facility and to ensure adequate emergency response capability.’

4.2 Security

The current security regulation does not allow an SMR licensee to propose a facility that will employ fully engineered security features in conjunction with an off-site response team that is

always available. In particular, the following clauses in the Regulation mandate the presence of at least two human security personnel at the facility at all times:

- Regulation section 15(2)(e) applicable to Category II materials: A security monitoring room shall be 'attended at all times by at least one nuclear security officer.'
- Regulation section 30: Every licensee shall at all times have available at a facility at which it carries on licensed activities a sufficient number of nuclear security officers to enable the licensee to comply with this Part and do the following: (a) control the movement of persons, materials and land vehicles; (b) conduct searches of persons, materials and land vehicles for weapons, explosive substances and Category I, II or III nuclear material; conduct preventative foot and land vehicle patrols of the facilities and the perimeter of the protected area to inspect for security breaches and vulnerabilities; (d) response to and assess alarm incidents; (e) apprehend and detain unarmed intruders; (f) observe and report on the movements of armed intruders; and (g) operate security equipment and systems.

However, the regulatory restriction on security is based on the Canadian Nuclear Security Regulations (SOR/2000-209), and it is unclear if the CNSC has an authority to accept an alternative approach to security implementation in an SMR licensing application. A clarification from CNSC would be necessary.

5. Summary

While the current regulatory approaches and processes seem to be adequate for the licensing of small nuclear power generation facilities, they will likely prevent the industry from maturing beyond the concept development stage as the lack of regulatory uncertainty reduction mechanisms will hamper investments. Hatch proposes that the CNSC provides an official definition for small modular reactors that fits the Canadian regulatory context. In addition, a front-end loaded licensing approach should be considered by the CNSC that will allow the industry to begin increasing regulatory approval certainty earlier in the project development cycle.

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Subject: Comments on Discussion Paper DIS-16-04

In response to the recent publication of CNSC's discussion paper DIS-16-04, titled Small Modular Reactors: Regulatory Strategy, Approaches and Challenges, Hatch is submitting the following comments on the regulation of fusion technologies described on page 27. It feels, however, that the discussion of fusion reactor regulation is somewhat out of context for the purpose of the current consultation.

While the current regulation defines a nuclear fusion reactor as a Class IA nuclear facility, it should be pointed out that certain fusion reactor concepts such as General Fusion's magnetic target fusion (MTF) system exhibit safety characteristics that are more similar to those of a Class IB nuclear facility. In a simplistic view, an MTF type facility consists of two parts; a storage and flow processing system holding considerable amount of tritium and activation products, and a nuclear reaction system that holds small amount of nuclear fuel.

While there could be considerable amount of neutron activated materials in the core, there are limited amount of nuclear fuel participating in the nuclear reaction at any given time. For a 100MJ reaction, 3.546×10^{19} D-T fusion reactions are necessary which requires 1.78×10^{-4} grams of tritium injection into the core. A concept like magnetic target fusion does not rely on sustained nuclear reaction but on precisely controlled and timed fuel injections and shock wave generations to cause discrete fusion reaction events. An uncontrolled mass release of radioactivity from the reactor core is not a technically feasible scenario with an MTF design. However, the majority of radioactive substances in the plant (e.g., tritium inventory and activation products in heat transport fluids) reside in the storage and process systems. Thus, the process system represents higher radiological risk in an MTF type fusion facility.

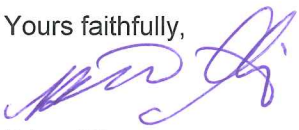
From a radiological risk perspective, the process/storage systems represent greater risk potential than the reactor in an MTF facility. Such facility would share a similar risk characteristics with a Class IB facility in Class I Nuclear Facilities Regulations (SOR/2000-204) described below:

(d) a plant, other than a Class II nuclear facility as defined in section 1 of the Class II Nuclear Facilities and Prescribed Equipment Regulations, for the processing or use, in a quantity greater than 10^{15} Bq per calendar year, of nuclear substances other than uranium, thorium or plutonium;

Considering the technical diversities in the emerging fusion energy industry, it is our opinion that the technology differences and potential risk factors of each system are reflected carefully in determining the

regulatory approaches . As the discussion paper indicates, the existing tools and requirements used for nuclear fission reactors should be used as a starting point in absence of a precedent setting fusion reactor in Canada. However, it would be important to remember that fission and fusion reactors come with fundamentally different safety concerns and the fission reactor based regulations are not blindly applied to the regulation of fusion systems.

Yours faithfully,



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BG:BG
Attachment(s)/Enclosure

cc: