Readiness For Regulating Small Modular Reactors

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Ramzi Jammal
Executive Vice-President and Chief Regulatory Operations Officer
Canadian Nuclear Safety Commission

Current Situation

Significant interest in potential deployment of small modular reactors (SMRs) in Canada

- 7 vendor design review (VDR) applications, and more to come
- Utility, provincial government interest
- Canadian Nuclear Laboratories – Request for Expression of Interest

“The committee recommends that the Government of Canada continue to support the development of SMRs, recognizing the potential for SMRs to provide clean and reliable power to remote and northern communities and open new areas to economically valuable resource development.”

–Federal Standing Committee on Natural Resources, June 2017 report

The CNSC has developed a complete framework to license new reactors … but SMRs present different challenges

What Is Different With SMRs?

Novel technologies

Can differ significantly from existing water-based Generation II, III reactors

- Use of technologies common in other industries but novel to reactors
- Coolant (metal, sodium, molten fuel, gas)
- Different approaches to defence in depth (passive features, containment provisions)

Novel approaches to deployment

Examples

- Operating model (reduced staffing / remote operation)
- Transportable reactors
- Security by design
- Fleets of reactors (environmental assessment [EA], licensing, credit for prior reviews)

Key regulatory challenges identified in CNSC discussion paper DIS-16-04, *Small Modular Reactors: Regulatory Strategy, Approaches and Challenges*

Strategy for Readiness

Increased regulatory certainty

- fairness, rigour, efficiency, transparency

Establishment of technical readiness

- knowledge and capacity, enabling processes

Establishment of priorities

- what needs to be done and by when

Increased awareness

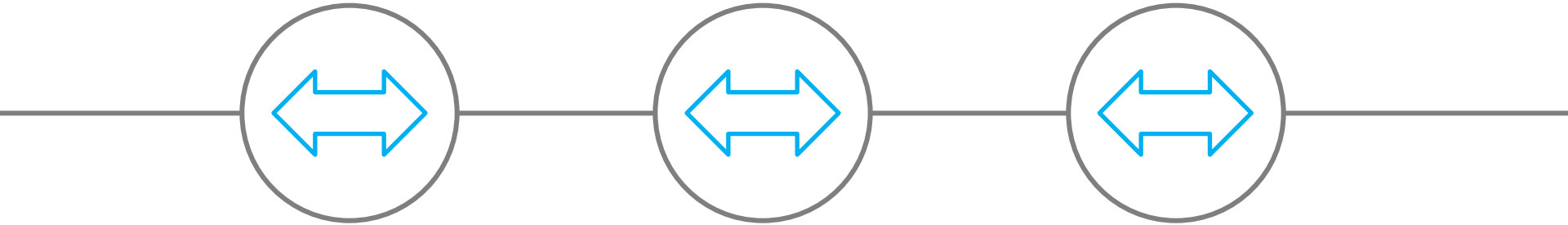
- internally and with external stakeholders

Elements of Strategy

Provide Leadership and Coordination

Small Modular Reactor Steering Committee (SMRSC)

Elements of Strategy



Regulatory framework

-*Nuclear Safety and Control Act* (NSCA), regulations, licences, regulatory documents

Risk-informed processes

-Managed processes covering strategic decision making

-Pre-licensing and licensing

-Compliance

Capable and agile staff

-Capacity/capability training

-International cooperation

Elements of Strategy

Communicate

Current Regulatory Framework

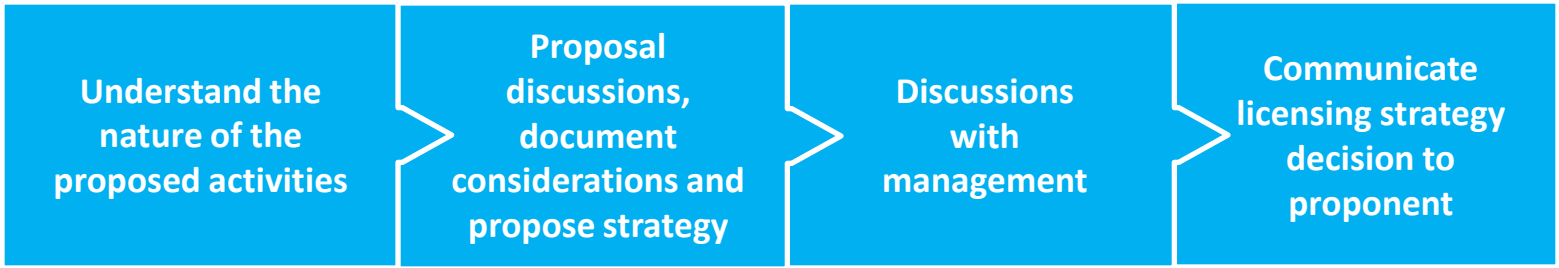
NSCA, regulations and complete suite of regulatory documents to ensure safety requirements in all aspect of design, construction, operation, etc.

All safety and control areas are covered

- Developed principally for water-cooled reactors
  - Complete set of licence application guides:
    - site preparation: REGDOC-1.1.1 (nearing completion)
    - construction: REGDOC 1.1.2 (being updated)
    - operation: REGDOC 1.1.3

Risk-Informed
Licensing Strategy

Approach for determining the licensing strategy for novel applications



Proposal is evaluated on hazards, complexity and novelty aspects

Licensing strategy provides
-Recommendation on the most appropriate regulations, application guides, regulatory documents and lead licensing service line

-Recommendations for scope and depth of licensing review for each safety and control area

SMR vendors are informed on expectations regarding information to be submitted in support of this process

Enhancements
Underway

Review processes

To confirm they are commensurate with the challenge

- Risk-informed resource allocation for licensing and compliance

Assess need for new processes

Examples

- Readiness regarding workforce capacity and capability
  - feedback from VDR experience as acquired
- Capacity and capability for vendor inspection
- Documenting lessons learned for future licensing stages
- Establish formal mechanism to document regulatory operating experience (OPEX) for eventual updates to the regulatory framework

International Cooperation

Benchmarking, informing and exchanging with other countries facing similar challenges, in a number of forums

- International Atomic Energy Agency SMR Forum, WGRNR, NEA Working Group on SMRs, MDEP, GSAR, bilateral with U.S. NRC
- U.S. DOE bilateral agreements led to molten salt reactor training and sharing of information on gas-cooled reactors
- CNSC VDR topics are well aligned with U.S. NRC conceptual design evaluation and U.K. ONR generic design assessment, although varying in depth and scope

CNSC technical review can be informed by other regulators' assessments

- Other regulators' assessments and conclusions still need to be reviewed to ensure compatibility with CNSC framework
- Allows use of research done for meeting other regulator's requirements

Establishment of Priorities

Early identification of challenges identified in DIS-16-04

- With time, other challenges will likely emerge
- Need for a prioritization process

Current focus

- Challenges arising from novelties in design (pre-licensing)
- Establishment of readiness

Focus will change through deployment

- First units will be prototypes or demonstration facilities, likely on a “controlled” site
  - focus on establishment of OPEX and economic demonstration
  - will not initially be faced with deployment-related issues
- Following units will face different challenges related to deployment
  - location, deployment approach, security, operating models, etc.

Regulatory Challenges
Identified

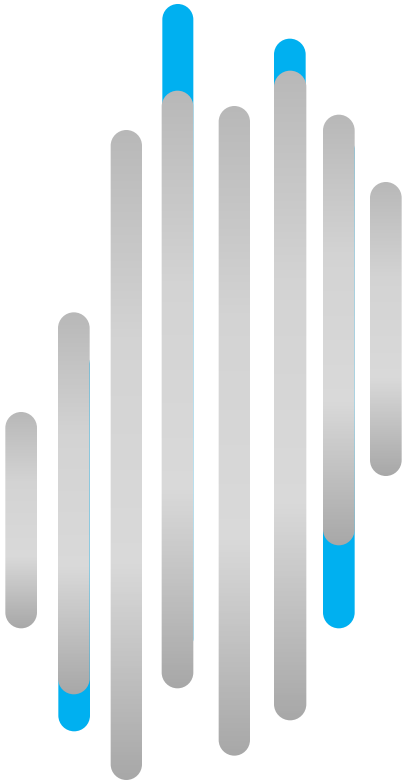
Design review	EA and licence to prepare site	Licence to construct	Licence to operate
• R&D to support safety case • Safeguards • DSA/PSA • Defence in depth and mitigation of accidents • Site security • Waste and Decommissioning • Subsurface civil structures • Management system	• Licensing of modular reactors • Emergency planning zones	• Licensing approach for demonstration reactor • Transportable reactors	Management system • Minimum shift complement • Increased use of automation / human-machine interface • Financial guarantees

Regulatory challenges identified in DIS-16-04
Report to be published in late September 2017 on the CNSC's website

Conclusions

- Current regulatory framework adequate for licensing of advanced technologies
  - provides flexibility to adapt to new types of reactors
  - needs solid management system processes and capable workforce
- Development of a strategy to explain CNSC approach and prioritize efforts will help provide regulatory clarity
- SMRSC to provide senior management leadership to set the foundation for the regulation of SMRs

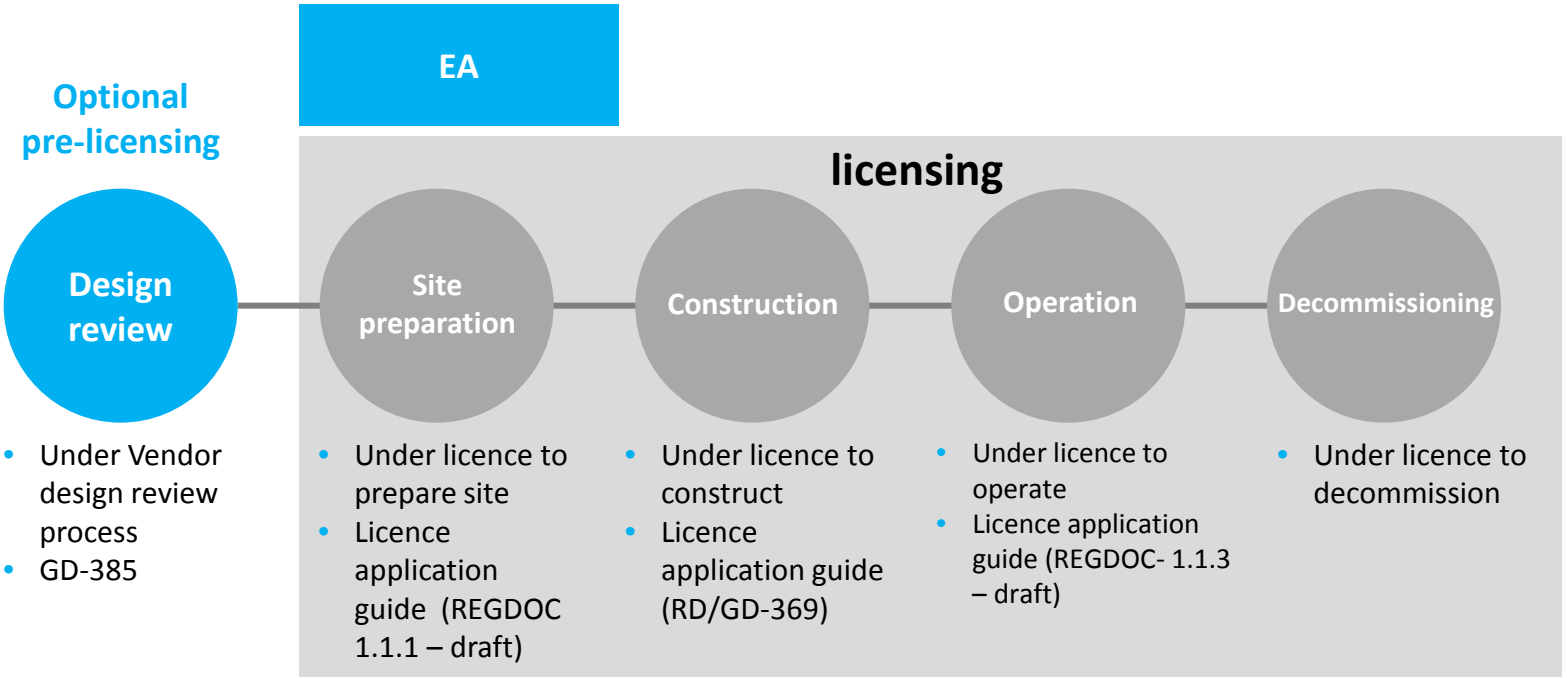
Appendix



Vendor Design Reviews

Vendor Design Review

Licensing Stages of a New Reactor Facility



The VDR provides information that can be leveraged to inform licensing for a specific project – it is not a design certification or a licence

Vendor Design Review

Phase 1 CNSC VDRs in Progress

VDR No.	Country of origin	Company	Reactor type / output per unit
1	Canada/U.S.	Terrestrial Energy	Molten salt integral / 200 MWe
2	U.S./Korea/China	UltraSafe Nuclear/Global First Power	High-temperature gas prismatic block / 5 MWe
3	Sweden/Canada	LeadCold	Molten lead pool fast spectrum / 3 – 10 MWe
4	U.S.	Advanced Reactor Concepts	Sodium pool fast spectrum /100 MWe
5	U.K.	U-Battery	High temperature gas prismatic block / 4 MWe
6	U.K.	Moltex Energy	Molten salt / ~1000 MWe
7	Canada/U.S.	StarCore Nuclear	High-temperature gas prismatic block / 10 MWe

Thank you!