

## Status of Pre-Licensing Activities in Canada

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 Rockville, Maryland, USA

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## National Highlights



- Canada-wide roadmap for SMRs under development
  - Involves a number of federal departments, provincial governments, power utilities and other interested stakeholders
  - Interested in a fleet approach but also considers supply chain
- Canadian Nuclear Laboratories' engaging with the public, vendors and governments
  - Can leverage expertise and facilities to facilitate technological development
- Established nuclear utilities
  - Are interested in becoming SMR operators for companies seeking to deploy SMRs in Canada
  - Have introduced a new industry forum to discuss SMR issues

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### Pre-Licensing Engagement CNSC Vendor Design Reviews - Overview

VDR No.	Company	Reactor type / output per unit	VDR Status
1	Terrestrial Energy	Molten salt integral / 200 MWe	PHASE 1 COMPLETED, Phase 2 Service Agreement under development
2	NuScale Power, LLC	Integral Pressurized Water / 50 MWe	Phase 2 Service Agreement under development
3	Ultra Safe Nuclear Corporation / Global First Power	MMR-5 and MMR-10, High Temperature Gas / 5MWe, 10 MWe	Phase 1 Assessment in progress, Phase 2 Service Agreement under development
4	Advanced Reactor Concepts Ltd.	ARC-100, Liquid Sodium / 100 MWe	Phase 1 Assessment in progress
5	Moltex Energy	Moltex Energy Stable Salt Reactor, Molten Salt / 300 MWe	Phase 1 Assessment in progress
6	LeadCold Nuclear Inc.	SEALER, Molten Lead / 3 MWe	Phase 1 on hold at vendor's request
7	URENCO	U-Battery, High-Temperature Gas / 4 MWe	Phase 1 Service Agreement under development
8	SMR, LLC. (A Holtec International Company)	SMR-160, Pressurized Light Water / 160 MWe	Phase 1 Service Agreement under development
9	StarCore Nuclear	StarCore Module, High-Temperature Gas / 10 MWe	Phase 1 Service Agreement under development

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## What Is Different With SMRs/Advanced Technologies?

### Novel technologies and associated uncertainties

#### 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)
- Security by design

### Novel approaches to deployment

#### Examples:

- New ownership and operating models
- Different ways of operating the plant (reduced staffing / autonomous operation with remote intervention)
- Factory fuelled transportable reactors
- Fleets of reactors (environmental assessment [EA], licensing, credit for prior reviews)

Key regulatory challenges were presented to the public in CNSC discussion paper DIS-16-04; Small Modular Reactors: Regulatory Strategy, Approaches and Challenges



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## Regulatory Challenges Identified in DIS-16-04 – Stakeholder Engagement

### Majority of feedback received from industry

#### Design Review

- R&D to support safety case
- Safeguards
- Deterministic Safety Assessment/Probabilistic Safety Assessment
- Defence in depth and mitigation of accidents
- Site security
- Waste and Decommissioning
- Subsurface civil structures
- Management system

#### EA and Licence to Prepare Site

- Licensing of modular reactors
- Emergency planning zones

#### Licence to Construct

- Licensing approach for demonstration reactor
- Transportable reactors

#### Licence to Operate

- Management system
- Minimum shift complement
- Increased use of automation / human-machine interface
- Financial guarantees

Feedback on the discussion paper is posted on the CNSC website and will inform future strategies for regulatory readiness



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## 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



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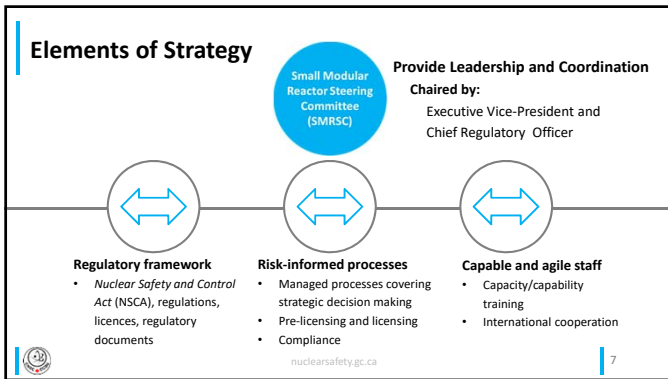
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## Pre-Licensing Engagement

Stakeholders are encouraged to engage with the CNSC early

Formal pre-licensing activities:

- **Vendors**
  - GD-385, Pre-licensing Review of a Vendor's Reactor Design
- **Potential Licensees**
  - Determining Appropriate Licensing Strategies for Novel Nuclear Technologies

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## Vendor Design Review Highlights

A vendor design review:

- Considers areas of design related to reactor safety, security and safeguards
- Provides feedback on the vendor's efforts to address Canadian requirements in their design and safety analysis
- Provides early feedback on the use of new design features and approaches
- Promotes early identification of key issues and fundamental barriers
- Identifies research activities that will support the design review and future licensing

**The Commission retains the final licensing decision**

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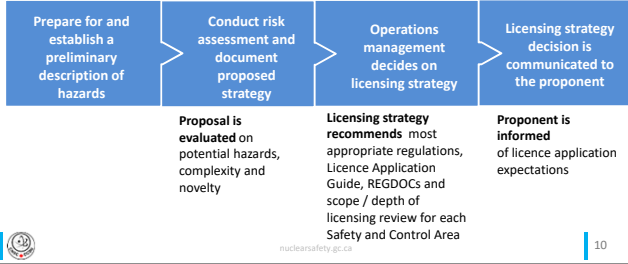
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## Risk Informed Licensing Strategies for Novel Nuclear Technologies

Ensures a systematic and consistent risk-informed approach



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## Enhancements Underway

### Early identification of challenges identified in DIS-16-04

- Next steps and follow-up actions identified in the *What We Heard Report* published September 2017
- With time, other challenges will likely emerge
- Near term challenges will be addressed first

### 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

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## Establishment of Priorities

### Development of SMR Licence Application Guide

- Taking into consideration different SMR technologies
- Further clarification on application of graded approach and consideration of alternative to requirements

### 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 an "existing" site
  - Focus on establishment of OPEX and economic demonstration
  - May not initially be faced with deployment-related issues
- Deployment of "standardized" units will face different challenges related to location, deployment approach, security, operating models, social acceptance, etc.

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## Conclusions

- Current regulatory framework adequate for licensing of projects using advanced technologies
  - Provides flexibility to adapt to new types of reactors
  - Needs solid management system processes and capable workforce
- Publication of a strategy to explain CNSC approach and prioritize efforts will help provide regulatory clarity
- CNSC senior management are providing leadership to set the foundation for the regulation of SMRs
- Regulatory objectives to deal with disruptive technologies



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Thank you!



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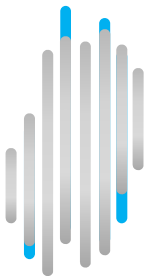
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## Appendix



### Vendor Design Reviews



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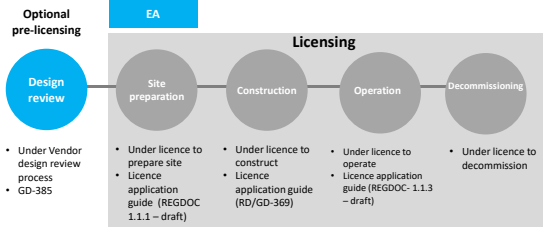
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## Vendor Design Review Licensing Stages of a New Reactor Facility



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




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