



# CNSC Perspective on the Regulation of SMRs including Molten Salt Reactors

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Canadian Nuclear Safety Commission Commission canadienne de sûreté nucléaire





#### Canadian Nuclear Safety Commission OUR MANDATE



#### REGULATE

the use of nuclear energy and materials to protect health, safety, and security and the environment



#### IMPLEMENT

Canada's international commitments on the **peaceful use of nuclear energy** 



#### DISSEMINATE

objective scientific, technical and regulatory information to the public

#### **75 years of Regulatory Experience**







### **CNSC** Regulatory Approach

- Objective, independent decision making and oversight
- Safety focus at all times; licensees ultimately responsible for safety
- Modern, agile, and flexible regulator for innovative technologies
- Relationship and trust building are key to social acceptance
- Pre-licensing activities including Vendor Design Reviews can help ensure reactor designers understand CNSC requirements





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#### Pre-Licensing Engagement and Licensing Process





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#### CNSC's Experience with SMRs

#### **VENDOR DESIGN REVIEWS**

#### PRE-LICENSING ACTIVITIES WITH FUTURE/PRESENT APPLICANTS

INTERNATIONAL AND MULTI-LATERAL COOPERATION

CAPABILITY AND CAPACITY BUILDING ACTIVITIES







### Design: Vendor Design Review

- An optional process for the CNSC to provide early feedback to the technology developer on:
  - how the vendor is addressing Canadian requirements in their design and safety analysis activities taking into account new design features and approaches
  - key issues emerging in a design that could impact a licensing process for a future project referencing the vendor's design
  - progress by the vendor to address outstanding issues
- Not binding on the Commission & licensing decisions
- Targeted towards the review of nuclear reactor designs







# Design: Vendor Design Reviews of Molten Salt Reactors

- TEI Integral Molten Salt Reactor
  - Completed Phase 1 in 2017
  - Phase 2 is in progress
- Moltex Energy Stable Salt Reactor
  - Completed Phase 1 in 2021
  - Moltex has a signed service agreement in place for Phase 2



Moltex Energy SSR Credit: Moltex Energy





### **Evolving Experience**

- CNSC staff take lessons learned from each VDR to better understand and assess each new design
- Design reviews of Molten Salt Reactors (MSRs) include the need to advance the following areas:
  - qualification of materials that can withstand extreme temperatures
  - development of sensors that can be immersed in molten salts to monitor parameters
  - analyzing how fuel chemistry changes over the life of the plant how it is monitored and controlled
  - validation of Software tools used to analyze molten salt performance



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#### Innovations in Fuel Technologies Related to SMRs

- Reprocessing spent CANDU fuel for use in fast spectrum SMR design
- Liquid-based fuels in MSRs
- HALEU fuels for SMRs/Advanced Concepts



Credit: US DOE

#### **CNSC** Maintains and Builds Readiness to Regulate



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# Safeguards

- The CNSC supports the concept of "Safeguards-by-Design" (SBD): the integration of safeguards considerations at the early design phase of a nuclear facility and throughout its life cycle
- Safeguarding bulk material in the form of molten salt introduces challenges in material accountancy and verification
- The CNSC is participating in an IAEA Member State Support Programme task on "Safeguards by Design for Small Modular Reactors"
  - aims to identify the key technical challenges for safeguards implementation and the steps that can be taken to support incorporating SBD principles into the designs









#### Waste Management

- Spent fuel intended for storage will need to be placed in interim storage, as is CANDU generated waste, until a long-term storage option is available
- The Nuclear Fuel Waste Act is flexible and accommodates new entrants
- The Nuclear Waste Management Office is engaged with SMR vendors, early in the process



### Summary/Conclusion

- The CNSC is ready to regulate and is increasing its readiness activities to perform effective and efficient reviews that allow for safe and timely innovation
- Our SMR experience is informed by a number of activities
- SMRs, including molten salt reactors do present some challenges and opportunities: The CNSC's risk informed approach allows for the regulation of non-traditional reactors in safe manner





# Questions?

Thank You!





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