Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CMD 23-H3.1A

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Supplementary Information

Renseignements supplémentaires

Presentation from the Royal Military College of Canada

Présentation du Collège militaire royal du Canada

In the Matter of the

À l'égard de

Royal Military College of Canada

Collège militaire royal du Canada

Application from the Royal Military College of Canada to renew its non-power reactor operating licence for its SLOWPOKE-2 facility

Demande du Collège militaire royal du Canada concernant le renouvellement de son permis d'exploitation d'un réacteur non producteur de puissance pour l'installation SLOWPOKE-2

Commission Public Hearing

Audience publique de la Commission

April 19, 2023

19 avril 2023

Canada

ROYAL MILITARY COLLEGE OF CANADA | COLLÈGE MILITAIRE ROYAL DU CANADA





SLOWPOKE-2 Licensing Renewal
RMC - NPROL-20.00/2023
CMD 23-H3.1A

Paul K. Chan, Professor
Licensing Contact
19th April 2023

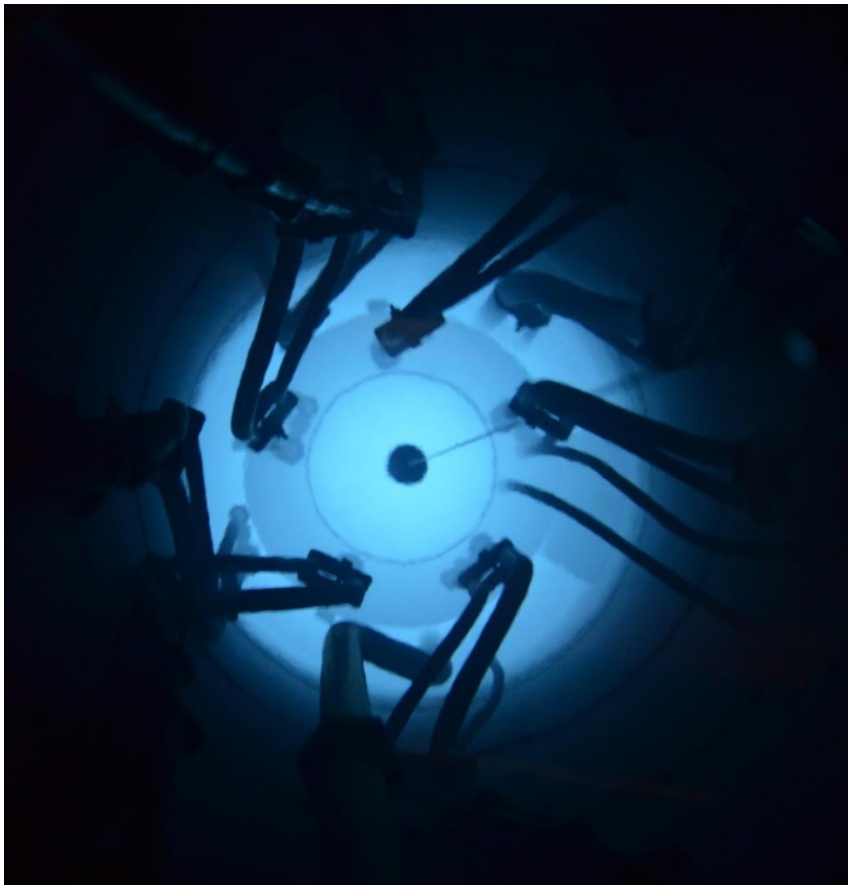
Objectives

1. Renewal of the Class 1A Non-Power Reactor Licence NPROL-20.00/2023 to operate the RMC SLOWPOKE-2 reactor for a period of 20 years to 30th June 2043.

2. Accept an increase to the maximum allowable excess reactivity of the reactor from 4.0 to 4.3 mk as stated in the operating limits and conditions.

Agenda

- Introduction
  - Overview
  - Description
  - Location
  - Capabilities
  - Application
- Refuelling
- Infrastructure
- Compliance
- Licence Amendment
- Responses to Intervenors
- Conclusions

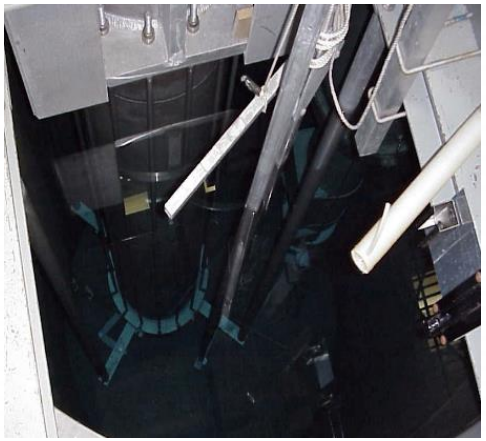


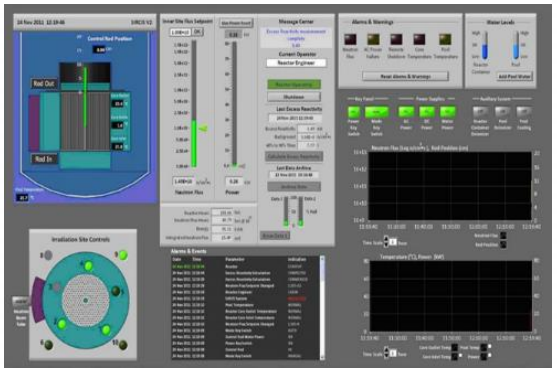
RMC SLOWPOKE-2 Reactor: An Overview since 1985

- Reactor has operated successfully for 38 years with no outstanding safety issues.
- Reactor designed with inherently safe features and is licensed in Canada for remotely attended operation.
- Reactor operated and routinely maintained by the users, with technical staff for shimming and refuelling.
- Reactor was refuelled in September 2021 with some in-core components inspected and reported to be “just like new”.
- Reactor met its original design intent and infrastructure has been upgraded significantly.
- Reactor provides an intense neutron source used for the education and research: Crown corporations, universities and nuclear industry.

RMC SLOWPOKE-2 Reactor: Description

- Nominal 20kW (17.6 kW_{th})
- With multi-layer of defence-in-depth:
  - Limited excess reactivity
  - Large negative temperature coefficient
  - Large thermalhydraulic margin
  - Cadmium auxiliary shutdown system
  - Remote shutdown button outside reactor room
- Digital control system: single Cadmium control/shutdown rod





RMC SLOWPOKE-2 Reactor: Kingston, Ontario

- Located on the traditional ands of the Hodinöhsö:ni, Anishinaabek, and Huron-Wendat Peoples, where RMC is proud to deliver the Officer Training and Indigenous Leadership Opportunity Year programs.
- RMC acknowledges the significance of these lands to the Indigenous peoples.

RMC SLOWPOKE-2 Reactor: Unique Capabilities

Neutron Activation Analysis (NAA), Liquid Scintillation Counting (LSC) and Gamma-spectroscopy

- Certified to ISO17025 for the wide range of isotopes
- Elemental analysis (alpha, beta and gamma radioactive decays)

Thermal Neutron Imaging

- Designed and built by AECL
- Structural fault analysis: determining the location of hydrogen-rich materials like water, explosives, or plastics inside metal components

Nuclear Forensics

- RMC is recognized within Canada's nuclear forensics community
- ICP-MS and DNC System (developed at RMC) for detecting fissile material

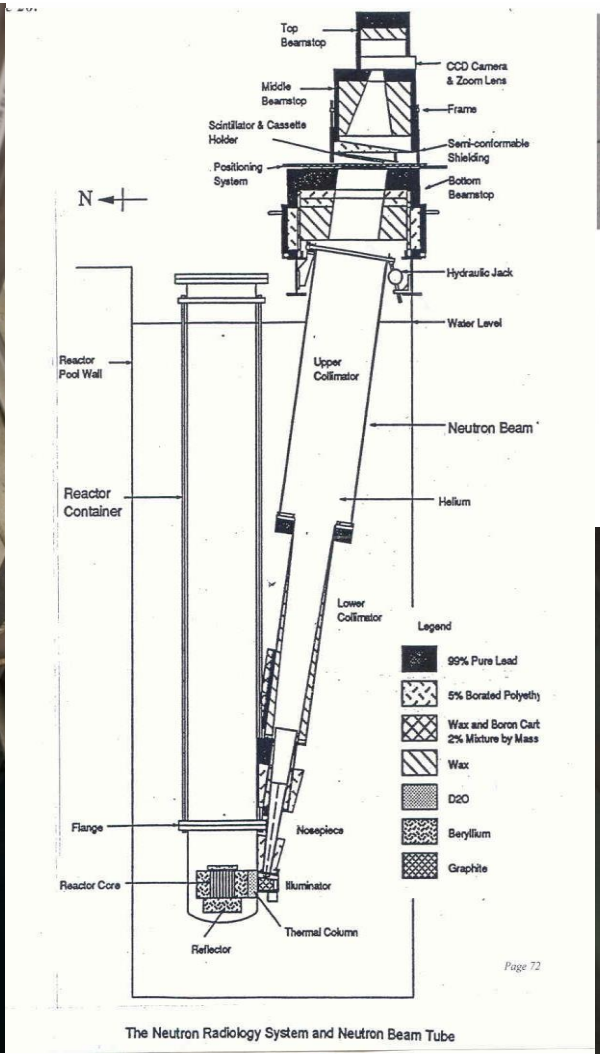
Producing Radioisotopes

- For research – eg., radiochronometry studies
- Clean-up exercises for first responders – Na-24, La-140

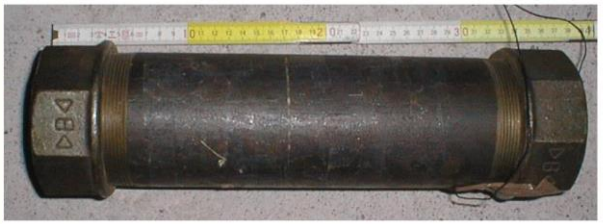
In-Pool irradiations for larger sample

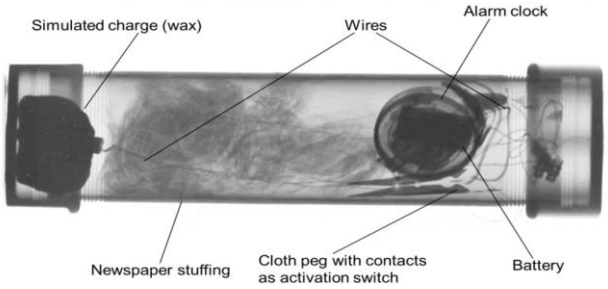
- Study radiation damage on novel materials

RMC SLOWPOKE-2 Reactor: Unique Capabilities (Neutron Beam Tube)



The Neutron Radiology System and Neutron Beam Tube





General Applications

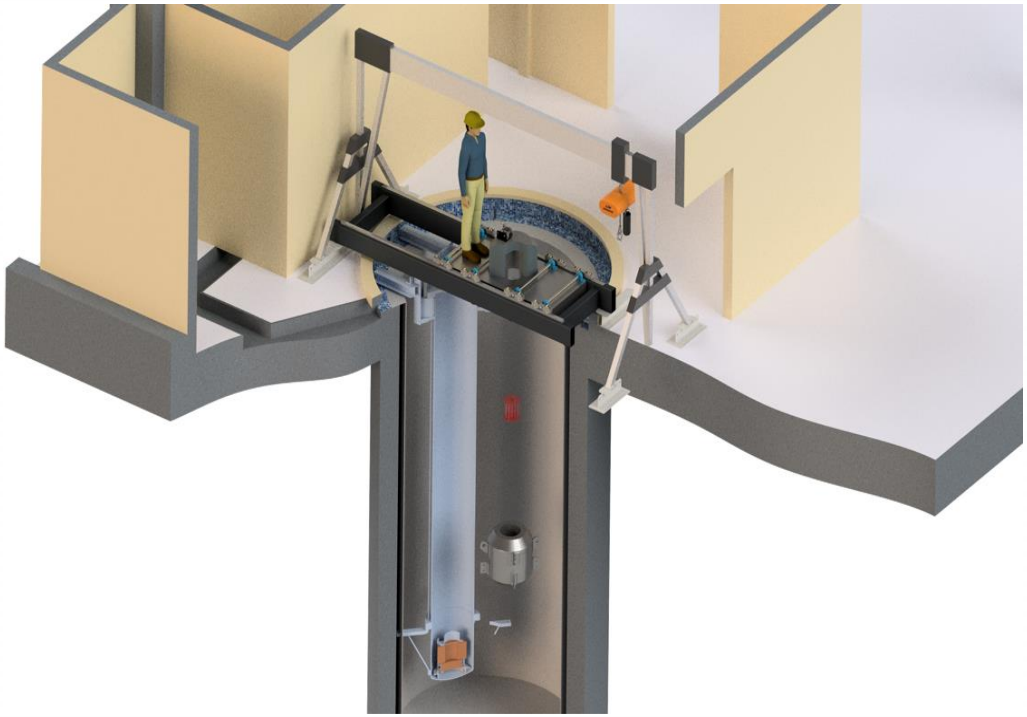
- Teaching, Research and Services, examples:
  - Provide highly qualified personnel for the Canadian Armed Forces and the Nuclear Industry through graduate research
  - Support the implementation of CBRN courses
  - Monitoring the environment
  - Production of radioisotopes: military exercises and SNOLAB
  - Check for radioactivity in soil and water from international base settlements and CFB bases
  - RMC Nuclear Engineering Program/ SMR training program

- Officers return to
  the Royal Canadian Navy (RCN),
  the Directorate of Nuclear Safety (D N Safe),
  Director Combat Systems Equipment Management (DCSEM),
  Defence Research Development Canada (DRDC)

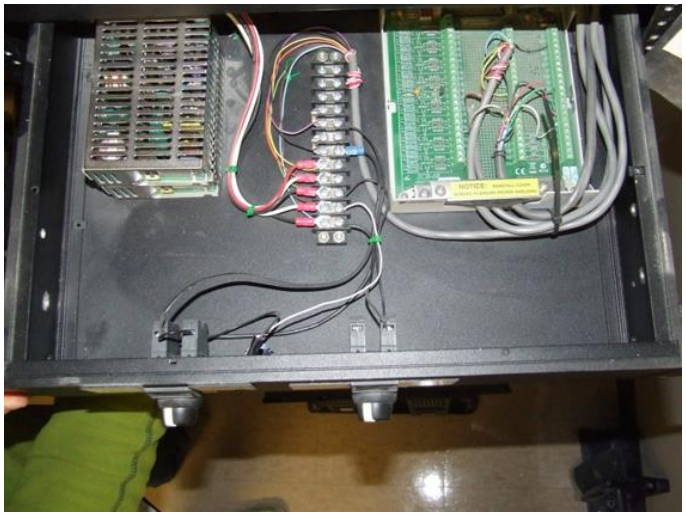
Refuelling: September 2021

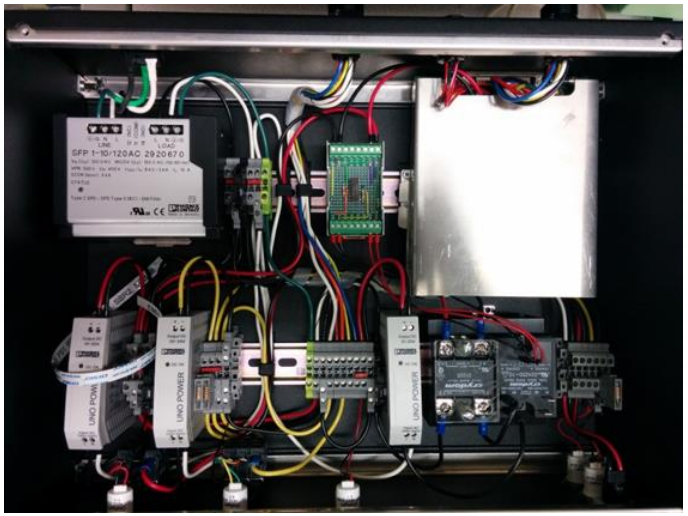
Irradiated Fuel Removal System – Platform and Transfer Flask

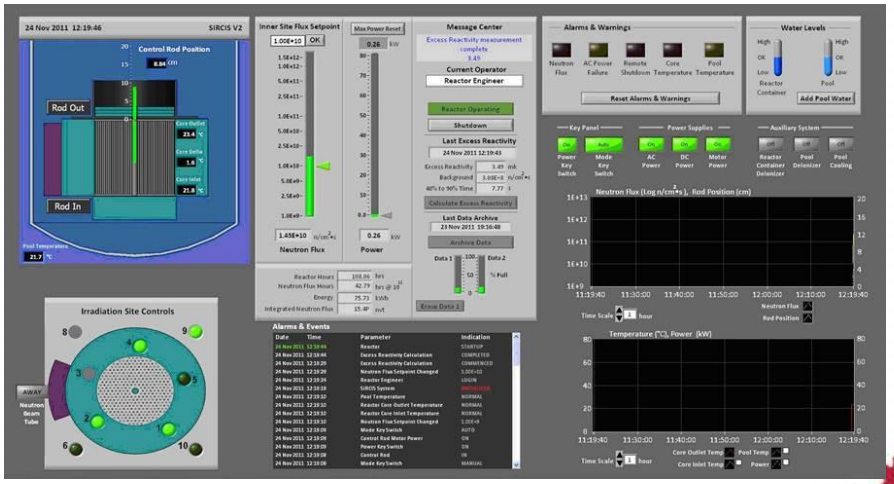
- Fuel cage was raised into the transfer flask
- Platform was translated
- Fuel cage was lowered into F-257
- F-257 was sealed, then removed from reactor pool
- 17 cycles of fuel pin addition / reactivity assessment in the reactor
- Approached to 4 mk excess reactivity with no Be shims
- 195 LEU pins / 3.66 mk



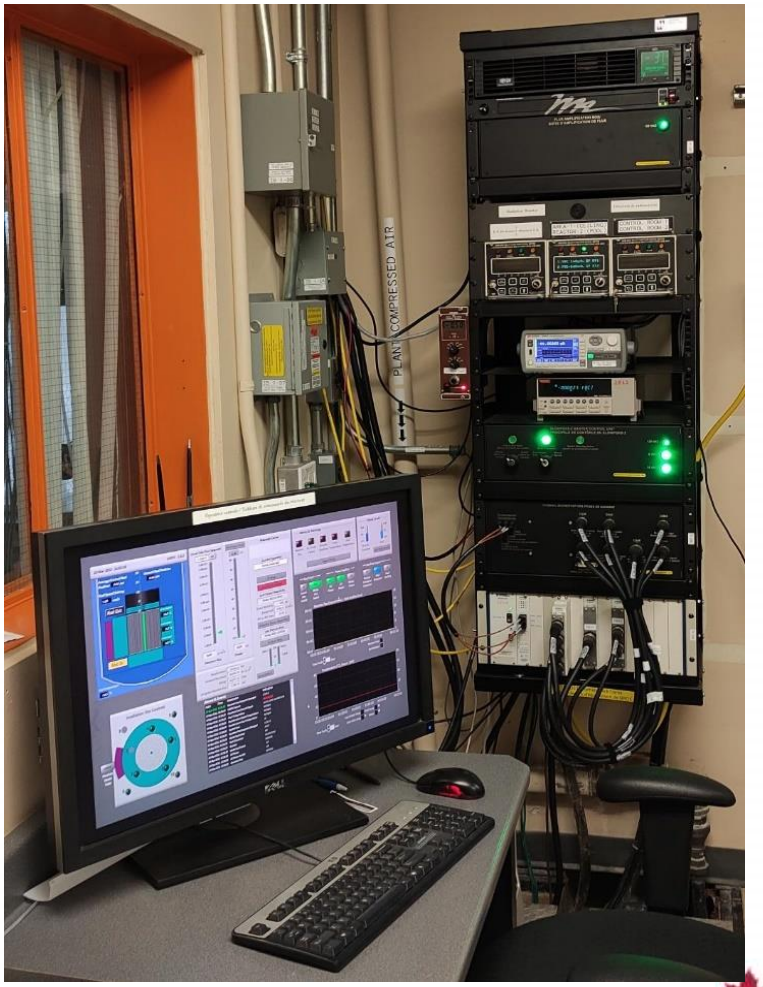
Infrastructure: Managing Change and Obsolescences
Electrical Safety Authority Field Evaluation (ESAFE)



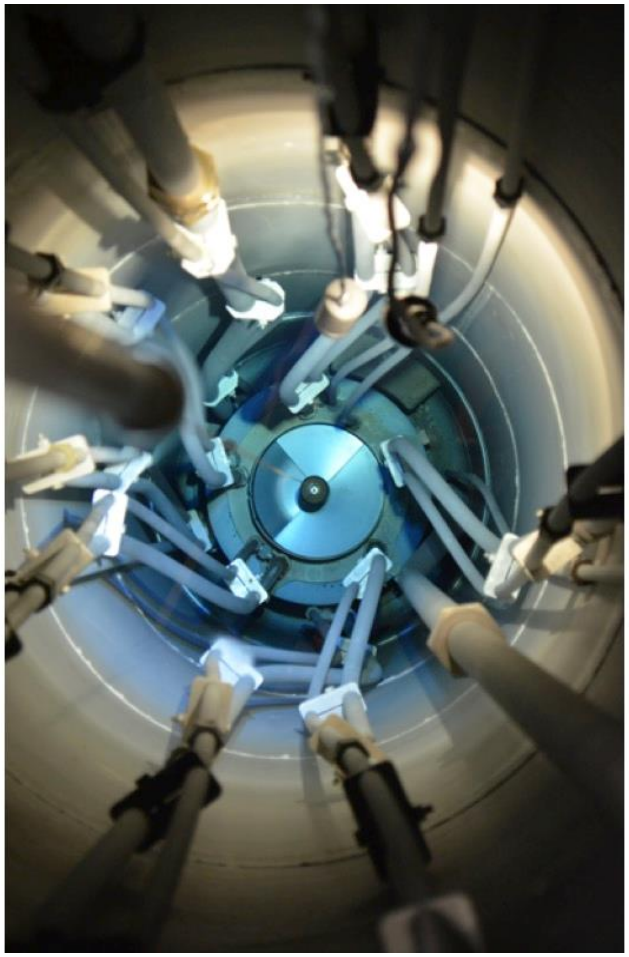


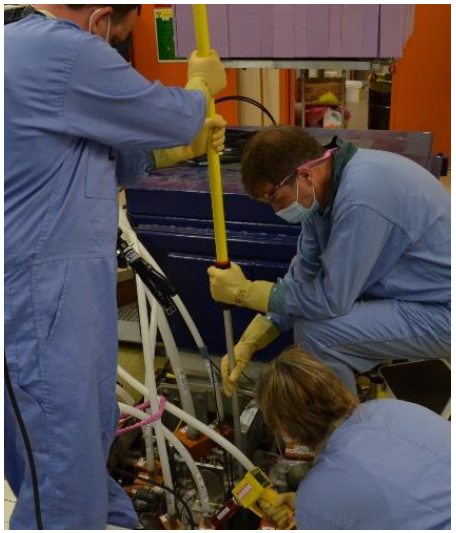


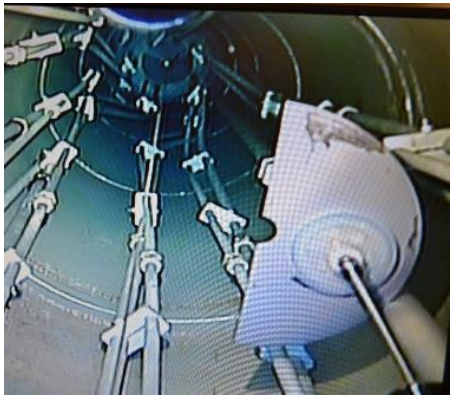
Infrastructure:
ESAFE is in Progress



Infrastructure:
Inside Reactor Container Inspected







Compliance

1. Documents updated in alignment with REGDOCs, for example: System Management Manual, Reactor Manual, Radiation Protection Program, Security Improvements, Public Information Program, Training Manual, Decommissioning Plan, Environmental Risk Assessment, Safety Analysis Report etc.

2. RMC CMD shows 100% compliance with all 14 Safety Control Areas and Other Regulatory Areas.

3. RMC continuously receives satisfactory rating from CNSC for all safety areas in the last 10 years.

4. RMC SLOWPOKE has successfully responded to and completed all actions and recommendations arising from inspections made by the CNSC during the last 10 years.

5. RMC SLOWPOKE has had minimal impact on public dose (6% of regulatory limit of 1 mSv/year) and on the environment for 38 years. The 2021 core is meeting the design intent and has no leakage of fission products.

Licence Amendment

1. RMC is requesting a licensing change in one of the operating limits: The maximum excess reactivity of the reactor is requested to be changed from 4.0 to 4.3 mk.

2. A safety assessment (analysis) supporting the request was submitted to CNSC.

<u>Reasons:</u>

- Mitigate the burden/dependence on reactor shimming in the future.
- Avoid unnecessary handling of hot shims by SLOWPOKE maintainers as per ALARA

Intervention #1

- RMC acknowledges the comments made by Mr. David Winfield and welcomes the input in his intervention document.
- RMC intends to continually improve the contents of the RMC SLOWPOKE-2 Facility SEP-5 Safety Analysis Report (SAR).
- RMC is collaborating with CNL to improve physics and thermalhydraulics models. PIE data from the recently discharged RMC's core is being characterized. Students are trained for the nuclear industry and DN Safe (CAF).
- These new data will be used to calibrate reactor power, quantify noises and update modelling approaches. As the new data becomes available, SAR will be updated in a periodic manner.

Intervention #2

- As federal government organizations/operations, Canadian Forces Base Kingston, RMC and the Facility are open to communication with and the inclusion of indigenous peoples in matters of mutual interest.
- RMC acknowledges the interest shown by the Curve Lake First Nation in the existence and operation of the SLOWPOKE-2 reactor and is looking forward to welcome their first visit.
- RMC has a publicly accessible web page, https://www.rmc-cmr.ca/en/chemistry-and-chemical-engineering/slowpoke-2-facility, devoted to communicating reactor operations to everyone in the surrounding community.
- RMC SLOWPOKE has not had any adverse effects on the land and on its surrounding environment since its commissioning in 1985.
- RMC established an Indigenous Knowledge and Learning Working Group and a program for indigenous youth from across the country called Indigenous Leadership Opportunity Year (ILOY Program).

Conclusions and a Final Remark

- Excellent general safety and radiation records.
- Proactive:
  - Collaborations with industry and government partners established
  - Continually working on knowledge retention and training
  - Neutron Beam Tube installed
  - ESAFE is being completed
  - Fire suppression system installed
- Established:
  - Succession planning
  - Infrastructure change and obsolesces managements
  - Public and indigenous communications through a public website and visits to the Facility
- Environmental: No or minimal impact
- Financial guarantee and decommissioning plan: Updated

REMARK: The SLOWPOKE-2 reactor has operated successfully for 38 years and expects to continue doing so for this requested licensing term of 20 years.