
Commission Meeting
August 22-23, 2018
CMD 18-M32.A

Staff Presentation
Report Format

Part 1: Research Reactors

• McMaster Nuclear Reactor
• Royal Military College of Canada SLOWPOKE-2
• University of Alberta SLOWPOKE-2
• Saskatchewan Research Council SLOWPOKE-2
• École Polytechnique de Montréal SLOWPOKE-2

Part 2: Class IB Accelerators

• TRIUMF
• Canadian Light Source Inc.
Scope

• Calendar years 2016 and 2017
• Last ROR for these facilities was for 2015 (CMD 16-M43)
• Highlights CNSC staff’s regulatory compliance efforts
• Provides a performance summary on all 14 Safety & Control Areas
• Focus on:
  – Radiation Protection
  – Environmental Protection
  – Conventional Health and Safety
Public Consultation

• April 3, 2018 – Notice of Participation at a Commission Meeting and Participant Funding Offered
• CMD was made available for public comments on June 22, 2018
• No interventions received
• One application for Participant Funding Program, but later withdrawn
• ROR is one of the pillars used by the CNSC to disseminate information
Regulating the Nuclear Sector (1/2)

• The CNSC regulates the nuclear sector in Canada:
  – protect the health, safety and security of Canadians 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

• Reduce risk to people and the environment from nuclear activities and facilities
CNSC regulates nuclear facilities based on:

- the provisions of the *Nuclear Safety and Control Act* (NSCA)
- the regulations under the NSCA
- the licences
- Regulatory Documents
- licensee documentation
Errata in CMD 18-M32

- Page 55: Section 3.9 made reference to contributions to a NRRR fund, which is not the case for Class IB facilities. Class IB facilities use letters of credit as Financial Guarantee instruments
Research Reactor Locations

- University of Alberta, Edmonton, AB (UoA)
- Saskatchewan Research Council, Saskatoon, SK (SRC)
- McMaster Nuclear Reactor, Hamilton, ON (MNR)
- Royal Military College, Kingston, ON (RMC)
- École Polytechnique de Montréal, Montréal, QC (EPM)

nuclearsafety.gc.ca
Research Reactors

- Low power
- Ambient temperature and pressure
- Light water
- Safety features
  - SLOWPOKES are self-limiting in power
  - MNR has a containment building
- Low environmental footprint
  - No liquid radiological releases
  - Dose to the public ≈ 1 µSv/yr

Very Low Risk
McMaster Nuclear Reactor

MNR is a 5 MW research reactor located on the campus of McMaster University in Hamilton

- Commissioned in 1959
- Licence NPROL-01.00/2024 was issued by the Commission in 2014 for a period of 10 years
- Medical isotopes – Iodine-125
- Neutron radiography
- Research

Picture shows two turbine blades exposed to neutron radiography at MNR. The blade on the left shows material from the molding process left in the cooling channels.

Photo: Applus+ website.
In this picture, we can see the Royal Military College in Kingston, Ontario. The SLOWPOKE reactor is located in the Sawyer Science and Engineering Building, identified by the circle.

Royal Military College of Canada (1/2)

- Royal Military College of Canada operate a SLOWPOKE-2 reactor on the campus in Kingston, ON
- Commissioned in 1985
- Licence NPROL-20.00/2023 issued in 2013 for 10 years
- Neutron activation analysis
- Neutron radiography
- Research and education
Royal Military College of Canada (2/2)

- Refueling of RMCC, starting in April 2019
- 32 years of operation with original core
- CNSC staff will increase compliance oversight during project
  - Licence to transport and export core
  - Commissioning of the new core
- Completion: 2021
University of Alberta (1/2)

- University of Alberta SLOWPOKE-2 reactor was located on the campus of University of Alberta in Edmonton, Alberta
- Operated between 1977 and 2017
- Facility was decommissioned in 2017
  - Core removed repatriated to the U.S. July 2017
  - All components removed
  - Pool water purified, drained
  - No contamination
Commissioned in April 1977, the University of Alberta’s Safe Low Power Kritical Experiment (SLOWPOKE) Nuclear Reactor Facility was a low-power reactor used to support research, teaching and industry. The reactor was located on the U of A main campus until the end of July 2017; the decommissioning was officially completed in June 2018.

- CNSC staff inspected the facility after decommissioning
  - Facility was confirmed clean - no contamination
- CNSC staff reviewed end-state report, including radiological survey data for all components
- Commission revoked operating licence NPROL-18.01/2023 on May 25, 2018

End-State: The facility can be repurposed for any non-nuclear activities without any restrictions
Saskatchewan Research Council (1/2)

- SRC operates a SLOWPOKE-2 reactor in Saskatoon, SK
- Licence NPROL-19.00/2023 was issued by the CNSC in 2013 for a period of 10 years
- Commissioned in 1981
- Fueled with HEU
- Reactor uses include:
  - Research
  - Neutron activation analysis
  - Teaching with University of Saskatchewan
Saskatchewan Research Council (2/2)

- SRC announced in 2017 it will cease operations
- HEU core will be repatriated to the U.S. by end of 2019 under legal agreements
- Next steps:
  - Application to amend the licence (Nov. 2018)
  - Application for transport & export licences (2019)
  - Inspection to verify the end-state (2019)
  - Application for licence to abandon (2020)
École Polytechnique de Montréal (1/2)

- ÉPM exploite un réacteur SLOWPOKE-2 sur le campus de l’Université de Montréal
- Exploitation depuis 1976
- Permis PERFP-9A.01/2023 émis par la CCSN en 2016 pour une durée de 7 ans
- Réacteur est utilisé pour :
  - Recherche
  - Enseignement
  - Analyse neutronique
École Polytechnique de Montréal (2/2)

- ÉPM exploite aussi un Assemblage Sous-Critique
- Permis consolidé avec celui du SLOWPOKE-2 en 2016
- Utilisé pour fins éducatives
- Dernière exploitation de l’Assemblage Sous-Critique remonte à 2012
## Performance Ratings for Research Reactors 2016 – 2017

<table>
<thead>
<tr>
<th>Safety and control area</th>
<th>MNR</th>
<th>U of A</th>
<th>SRC</th>
<th>RMCC</th>
<th>ÉPM</th>
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<tbody>
<tr>
<td>Management system</td>
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<td>Conventional health and safety</td>
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<td>Emergency management and fire protection</td>
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<td>Safeguards and non-proliferation</td>
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<td>Packaging and transport</td>
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</tbody>
</table>

Explanations:
- **FS**: Fully Satisfactory
- **SA**: Satisfactory
- **BE**: Below expectations
- **UA**: Unacceptable

Explanation of rating methodology in annex of this presentation

[link to nuclearsafety.gc.ca]

No events or operational challenges at the SLOWPOKES

- No radiation exposures
- No unauthorized releases to the environment
- The SLOWPOKES operated within their Operating Limits and Conditions
July 2016: There was a fire at a McMaster University service building in the vicinity of the reactor building. The reactor was not affected by the fire.

July 2017: MNR was started up with the Fission Products Monitor (FPM) offline for approximately 10 minutes. This was in contravention of the Operating Limits and Conditions.

No safety consequences as a result of these incidents.
Regulatory Compliance

- Risk-informed approach
  - Risk of the facility
  - Operational performance
  - Compliance history
  - Changes in operations
  - Changes in regulatory framework
- 10-year baseline inspection plans
- Annual compliance verification plans

CNSC staff conduct ongoing compliance verification
## Regulatory Effort for Research Reactors in 2016 – 2017

<table>
<thead>
<tr>
<th>Facility</th>
<th>2016</th>
<th></th>
<th>2017</th>
<th></th>
<th></th>
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<tr>
<td></td>
<td>Inspections</td>
<td>Licensing (person-days)</td>
<td>Compliance (person-days)</td>
<td>Inspections</td>
<td>Licensing (person-days)</td>
<td>Compliance (person-days)</td>
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<tr>
<td>McMaster Nuclear Reactor</td>
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<td>57</td>
<td>118</td>
<td>1</td>
<td>56</td>
<td>110</td>
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<tr>
<td>University of Alberta</td>
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<td>32</td>
<td>49</td>
<td>1</td>
<td>73</td>
<td>16</td>
<td></td>
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<tr>
<td>Saskatchewan Research Council</td>
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<td>13</td>
<td>78</td>
<td>1</td>
<td>7</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Royal Military College of Canada</td>
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<td>42</td>
<td>60</td>
<td>1</td>
<td>10</td>
<td>23</td>
<td></td>
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<tr>
<td>École Polytechnique de Montréal</td>
<td>0</td>
<td>19</td>
<td>19</td>
<td>1</td>
<td>16</td>
<td>14</td>
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<tr>
<td><strong>Totals</strong></td>
<td>4</td>
<td><strong>163</strong></td>
<td><strong>324</strong></td>
<td><strong>5</strong></td>
<td><strong>162</strong></td>
<td><strong>187</strong></td>
<td></td>
</tr>
</tbody>
</table>
Radiation Protection SCA

This SCA encompasses the following specific areas:

- Application of ALARA
- Worker Dose Control
- Radiation Protection Program Performance
- Radiological Hazard Control
- Estimated Dose to the Public

All research reactor facilities were rated Satisfactory for this SCA
## Radiation Protection

### Effective Annual Dose to Workers 2016 – 2017

<table>
<thead>
<tr>
<th>Dose Statistics</th>
<th>Non-NEWs</th>
<th>NEWs</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>SRC</td>
<td>ÉPM</td>
</tr>
<tr>
<td>Average effective dose (mSv)</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Maximum individual effective dose (mSv)</td>
<td>0.28</td>
<td>0.23</td>
</tr>
<tr>
<td>Total persons monitored (typical)*</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Regulatory dose limit</td>
<td>1 mSv</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Number of persons can vary slightly from year to year. RMCC has NEWs and non-NEWS
Radiation Protection (MNR 5-year trend)

<table>
<thead>
<tr>
<th>Year</th>
<th>Average effective dose (mSv)</th>
<th>Maximum effective dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>0.54</td>
<td>3.93</td>
</tr>
<tr>
<td>2014</td>
<td>0.39</td>
<td>3.34</td>
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<tr>
<td>2015</td>
<td>0.38</td>
<td>3.22</td>
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<tr>
<td>2016</td>
<td>0.36</td>
<td>3.64</td>
</tr>
<tr>
<td>2017</td>
<td>0.34</td>
<td>3.91</td>
</tr>
</tbody>
</table>
Radiation Protection (MNR extremity 5-year trend)

Average Equivalent Dose (mSv)  
- 2013: 5.9  
- 2014: 5.9  
- 2015: 6.2  
- 2016: 6.9  
- 2017: 6.2  

Maximum individual equivalent dose (mSv)  
- 2013: 22.5  
- 2014: 27.3  
- 2015: 36.4  
- 2016: 42.0  
- 2017: 44.0  

Annual Effective Dose Limit for a NEW (500 mSv)
Radiation Protection (SLOWPOKE 5-year trend)

<table>
<thead>
<tr>
<th>Year</th>
<th>Average effective dose (mSv)</th>
<th>Maximum effective dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2014</td>
<td>0.03</td>
<td>0.42</td>
</tr>
<tr>
<td>2015</td>
<td>0.02</td>
<td>0.29</td>
</tr>
<tr>
<td>2016</td>
<td>0.05</td>
<td>0.29</td>
</tr>
<tr>
<td>2017</td>
<td>0.05</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Annual Effective Dose Limit for a NEW (50 mSv)
Environmental Protection SCA

This SCA encompasses the following relevant specific areas for Research Reactors: Effluent and Emissions Control (releases), and Assessment and Monitoring

- Airborne releases small – Undetectable at SLOWPOKES
- MNR has environmental monitoring stations
- No liquid releases at any of the Research Reactors

All research reactor facilities were rated Satisfactory for this SCA
Environmental Protection – MNR Argon-41 releases

Ar-41 Releases (Bq)

- **DRL (1.3E+15 Bq/year)** based on public dose limit 1 mSv/year
- **Action level (1.6E+13 Bq/year)** results in a release of 0.012 mSv/year

<table>
<thead>
<tr>
<th>Year</th>
<th>McMaster Nuclear Reactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1.05E+12</td>
</tr>
<tr>
<td>2014</td>
<td>9.30E+11</td>
</tr>
<tr>
<td>2015</td>
<td>8.40E+11</td>
</tr>
<tr>
<td>2016</td>
<td>7.10E+11</td>
</tr>
<tr>
<td>2017</td>
<td>6.90E+11</td>
</tr>
</tbody>
</table>
Environmental Protection – MNR Iodine-125 Releases

- DRL (9.4E+12 Bq/year) based on public dose limit 1 mSv/year
- Action level (1.0E+10 Bq/year) results in a release of 0.001 mSv/year

<table>
<thead>
<tr>
<th>Year</th>
<th>I-125 Releases (Bq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1.80E+08</td>
</tr>
<tr>
<td>2014</td>
<td>1.70E+08</td>
</tr>
<tr>
<td>2015</td>
<td>1.70E+08</td>
</tr>
<tr>
<td>2016</td>
<td>2.50E+08</td>
</tr>
<tr>
<td>2017</td>
<td>8.20E+08</td>
</tr>
</tbody>
</table>

Action level (1.0E+10 Bq/year) results in a release of 0.001 mSv/year

DRL (9.4E+12 Bq/year) based on public dose limit 1 mSv/year
Conventional Health and Safety SCA

This SCA encompasses the following relevant specific areas for Research Reactors: Performance, Practices and Awareness

• There were no lost-time injuries at any of the small research reactors during 2016 – 2017

All research reactor facilities were rated Satisfactory for this SCA
Other Matters of Interest

• Public Information and Disclosure
• Financial Guarantees
• Regulatory Developments
Public Information and Disclosure

• Required to implement Public Information and Disclosure programs
• Provide the public with timely information about the health, safety and security, and unusual occurrences
• All licensees provided operations information on their websites.
• Other communications activities:
  – Open houses
  – Outreach events
  – Facility tours
  – Community events
Financial Guarantees

• Licensees provide a guarantee with sufficient financial resources available to fund decommissioning activities:
  – dismantling, decontamination and closure of the facility
  – any post-decommissioning monitoring or institutional control measures that may be required
  – subsequent long-term management or disposal of all wastes, including used fuel
• Financial Guarantees are accepted by the Commission

The CNSC requires licensees to maintain and revise preliminary decommissioning plans every five years
Financial Guarantees Research Reactors

<table>
<thead>
<tr>
<th>Facility</th>
<th>Nuclear Reactor Restricted Reserve value Canadian dollars</th>
<th>Other instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>McMaster University</td>
<td>$12,539,090</td>
<td>N/A</td>
</tr>
<tr>
<td>University of Alberta</td>
<td>N/A Decommissioning completed</td>
<td>N/A Decommissioning completed</td>
</tr>
<tr>
<td>Saskatchewan Research Council</td>
<td>$5,100,000</td>
<td>N/A</td>
</tr>
<tr>
<td>Royal Military College of Canada</td>
<td>NA</td>
<td>Commitment from National Defence</td>
</tr>
<tr>
<td>École Polytechnique de Montréal</td>
<td>$498,160</td>
<td>Letter of credit for $800,000</td>
</tr>
</tbody>
</table>

Notes:
1. N/A: Not Applicable
2. RMCC is exempt since it is a federal entity owned by National Defence
3. Financial guarantee for École Polytechnique is currently under review
## Regulatory Document Developments

<table>
<thead>
<tr>
<th>Regulatory document</th>
<th>Publication</th>
<th>Status</th>
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<tbody>
<tr>
<td>REGDOC-2.2.2: Personnel Training, Version 2</td>
<td>2016</td>
<td>Implemented</td>
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<tr>
<td>REGDOC-2.9.1: Environmental Protection: Environmental Principles, Assessments and Protection Measure, version 1.1</td>
<td>2017</td>
<td>Implemented</td>
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<tr>
<td>REGDOC-2.10.1: Nuclear Emergency Preparedness and Response, version 2</td>
<td>2017</td>
<td>Implemented</td>
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<tr>
<td>REGDOC-2.13.1: Safeguards and Nuclear Material Accountancy</td>
<td>2018</td>
<td>Implementation plans</td>
</tr>
<tr>
<td>REGDOC-3.2.1: Public Information and Disclosure</td>
<td>2018</td>
<td>Implementation plans</td>
</tr>
</tbody>
</table>

**No gap in regulatory requirements**

nuclearsafety.gc.ca
Updates to Industry Standards Applicable to Research Reactors

- Licence Conditions Handbooks are updated to reflect these changes as part of the periodic revision cycle

<table>
<thead>
<tr>
<th>Standard</th>
<th>Published</th>
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<tbody>
<tr>
<td>N286-12 (R2017) Management system requirements for nuclear facilities</td>
<td>2012</td>
<td>Implementation plans</td>
</tr>
<tr>
<td>N292.1-16 Wet storage of irradiated fuel and other radioactive materials</td>
<td>2016</td>
<td>Implemented at MNR. Not applicable to SLOWPOKES</td>
</tr>
</tbody>
</table>

CNSC staff verify the implementation as part of ongoing compliance verification activities
Conclusion Part 1 Research Reactors

- Research reactors operate safely
- No radiological dose limit exceeded
- No unauthorized environmental releases
- No lost-time injuries
- Research reactor facilities are rated Satisfactory or Fully Satisfactory in all 14 SCAs
- CNSC staff continue to provide regulatory oversight of the research reactor facilities in a risk-informed approach through:
  - inspections
  - review of licensee documents
  - effective implementation of CNSC’s regulatory framework
Overview

Class IB accelerator facilities presented with research reactors:

- Similar low-risk
- Low environmental footprint
- Similar compliance programs
Class IB Particle Accelerator Facility Locations

- Tri University Meson Facility (TRIUMF)
  Canada’s national laboratory for particle and nuclear physics.
- Canadian Light Source Inc. (CLS)
  Located on the main campus of the University of Saskatchewan. In Saskatoon, Saskatchewan.

nuclearsafety.gc.ca
The photo on the right shows the 520 MeV cyclotron tank open.

TRIUMF

- TRIUMF is located on the University of British Columbia campus in Vancouver Commissioned in 1959
- Licence PA1OL-00/2022 issued in 2012 for a 10-year period
- The 520 MeV cyclotron accelerator has been in operation for over 40 years
- Medical isotopes
- Owned and operated as a joint venture by a consortium of 18 Canadian universities
- Approximately 560 persons working at TRIUMF
CLSI operates a synchrotron facility, on the University of Saskatchewan campus in Saskatoon, Saskatchewan

- Licence PA10L-02.01/2022 issued in 2012 for a 10-year period
- In operation since 2005
- Consists of three major accelerator systems:
  - 300 MeV linear accelerator
  - booster ring that accelerates electrons up to 2.9 Giga-electron volts (GeV)
  - storage ring that keeps electrons circulating at this energy for several hours
Part 2
Performance Ratings for Class IB Accelerators 2016 – 2017

<table>
<thead>
<tr>
<th>Safety and control area</th>
<th>CLSI 2016</th>
<th>CLSI 2017</th>
<th>TRIUMF 2016</th>
<th>TRIUMF 2017</th>
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<td>FS</td>
<td>SA</td>
<td>SA</td>
</tr>
<tr>
<td>Safeguards and non-proliferation</td>
<td>N/A*</td>
<td>N/A*</td>
<td>FS</td>
<td>FS</td>
</tr>
<tr>
<td>Packaging and transport</td>
<td>FS</td>
<td>FS</td>
<td>SA</td>
<td>SA</td>
</tr>
</tbody>
</table>

* N/A: There are no safeguards verification activities associated with CLSI

Explanation of rating methodology in annex of this presentation

FS: Fully Satisfactory
SA: Satisfactory
BE: Below expectations
UA: Unacceptable
Reported Events - TRIUMF

• June 2017: Irradiation of TR30-2 cyclotron cadmium target with a current of 375 μA for 30 minutes
  – Exceeded TRIUMF’s licence operating limit of 350 μA for this type of target
  – There were no consequences as a result of the event

• August and September 2017: Two unintentional releases of 40 GBq of carbon-11
  – The releases amounted to 0.1% of the full site annual releases
  – Maximum dose received by individual < 0.3 μSv as a result of release

No safety consequences as a result of these events.
CNSC staff verified that corrective actions developed to prevent recurrence of both events have been implemented.
Reported Events – CLSI (1/2)

• On July 14, 2016, a threat was made by an anonymous caller identifying himself as a member of ISIS. The incident was determined to be a hoax.

• On October 12, 2016, CLSI discovered that an electrical disconnect switch was not locked in the ‘off’ position prior to working on 600V power supply:
  − CLSI took appropriate actions to correct the Lock out Tagout (LOTO) process
  − CNSC staff conducted a targeted inspection to confirm the corrective actions were implemented

No safety consequences as a result of these incidents
Reported Events – CLSI (2/2)

- February 2017: A wiring error in the Linac Access Control Interlock System (ACIS) hardwire system was discovered
  - CLSI reviewed all accelerator ACIS design and installation and took appropriate actions

No safety consequences as a result of these events. CNSC staff verified that corrective actions developed to prevent recurrence have been implemented
Regulatory Compliance

• The Class IB accelerators are low-risk facilities
• Primary risk is prompt radiation
• Environmental releases are very small
• Regulatory compliance efforts typically focus on:
  – radiation protection
  – environmental protection
  – conventional health and safety
# Regulatory Effort Class IB Accelerators in 2016 – 2017

<table>
<thead>
<tr>
<th>Facility</th>
<th>2016</th>
<th></th>
<th></th>
<th>2017</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inspections</td>
<td>Licensing (person-days)</td>
<td>Compliance (person-days)</td>
<td>Inspections</td>
<td>Licensing (person-days)</td>
<td>Compliance (person-days)</td>
</tr>
<tr>
<td>TRIUMF</td>
<td>3</td>
<td>8</td>
<td>156</td>
<td>2</td>
<td>4</td>
<td>144</td>
</tr>
<tr>
<td>CLSI</td>
<td>1</td>
<td>6</td>
<td>54</td>
<td>2</td>
<td>21</td>
<td>96</td>
</tr>
<tr>
<td>Totals</td>
<td>4</td>
<td>14</td>
<td>210</td>
<td>4</td>
<td>25</td>
<td>240</td>
</tr>
</tbody>
</table>
The ratings for the Radiation Protection SCA for all Class IB accelerator facilities were Satisfactory or better and remain unchanged from previous five years.
Radiation Protection (TRIUMF 5-year Trend)

Maximum dose to non-NEWS was 0.15 mSv
Maximum dose to non-NEWS was 0.11 mSv
Radiation Protection
Maximum Effective Dose to the Public 2013 – 2017

- Maximum Effective Dose to a Member of the Public – TRIUMF

<table>
<thead>
<tr>
<th>Dose Data</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>Regulatory Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum effective dose (mSv) TRIUMF</td>
<td>0.012</td>
<td>0.016</td>
<td>0.011</td>
<td>0.010</td>
<td>0.007</td>
<td>1 mSv/year</td>
</tr>
</tbody>
</table>

- Effective Dose to a Member of the Public – CLSI:
  Natural radiation background levels
Environmental Protection SCA

This SCA encompasses the following specific areas for the Class IB Accelerators:

- Effluent and Emissions Control (releases)
- Environmental Management System (EMS)
- Assessment and Monitoring
- Protection of the Public
- Environmental Risk Assessment

Environmental protection SCA was rated Satisfactory for TRIUMF and Fully Satisfactory for CLSI
Environmental Protection (TRIUMF Airborne Releases)

<table>
<thead>
<tr>
<th>Year</th>
<th>% of DRL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1.16</td>
</tr>
<tr>
<td>2014</td>
<td>1.58</td>
</tr>
<tr>
<td>2015</td>
<td>0.94</td>
</tr>
<tr>
<td>2016</td>
<td>1.04</td>
</tr>
<tr>
<td>2017*</td>
<td>0.64</td>
</tr>
</tbody>
</table>

* Updated Derived Release Limit (DRL) calculations to align with CSA N288.1-14
Environmental Protection
TRIUMF-Liquid Effluent Release to Sanitary Sewer 2013 – 2017

- Liquid effluent releases are being controlled effectively
- No action levels were exceeded

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2013 (% DRL)</th>
<th>2014 (% DRL)</th>
<th>2015 (% DRL)</th>
<th>2016 (% DRL)</th>
<th>2017b (% DRL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of various isotopes</td>
<td>3.79E-6</td>
<td>1.21E-6</td>
<td>3.81E-7</td>
<td>5.76E-7</td>
<td>4.61E-6</td>
</tr>
</tbody>
</table>

a: 100% of the Derived Release Limit equals a 1 mSv annual dose (regulatory limit for member of the public)
b: Updated DRL calculations to align with CSA N288.1-14
Environmental Protection (CLSI)

- CLSI operates an accelerator that does not produce any emissions
- An inspection was performed in July 2017 and confirmed that CLSI does not release radiological contaminants to the environment
Conventional Health and Safety SCA

- Satisfactory for all Class IB accelerator facilities
- Following the inspection in July 2017, the rating for CLSI increased from Satisfactory to Fully Satisfactory
Conventional Health and Safety
Class IB Accelerator Facilities Lost-time Injuries 2013 – 2017

- Lost-time injuries remained low: 4 LTIs for 2016 – 2017
- Class IB accelerators implemented Conventional Health and Safety programs satisfactorily
- Protected the health and safety of persons working in their facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIUMF</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CLSI</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Other Matters of Interest

- Public Information and Disclosure
- Financial Guarantees
- Regulatory Developments
Public Information and Disclosure

• Required to implement Public Information and Disclosure programs
• Provide the public with timely information about the health, safety and security
• All licensees provided operations information on their websites
• Other communications activities:
  – Lectures
  – Outreach events
  – Facility tours
  – Community events
  – Social media
Financial Guarantees

- TRIUMF and CLSI provide a guarantee with sufficient financial resources available to fund decommissioning activities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Canadian dollar amount (Letter of credit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLSI</td>
<td>10,241,800</td>
</tr>
<tr>
<td>TRIUMF</td>
<td>10,800,000</td>
</tr>
</tbody>
</table>
### Regulatory Document Developments

**Class IB Accelerators**

<table>
<thead>
<tr>
<th>Regulatory document</th>
<th>Publication</th>
<th>TRIUMF Status</th>
<th>CLSI Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGDOC-2.2.2: Personnel Training, Version 2</td>
<td>2016</td>
<td>Implemented</td>
<td>Implemented</td>
</tr>
<tr>
<td>REGDOC-2.9.1: Environmental Protection: Environmental Principles, Assessments and Protection Measures</td>
<td>2017</td>
<td>Implemented</td>
<td>Implemented</td>
</tr>
<tr>
<td>REGDOC-2.13.1: Safeguards and Nuclear Material Accountancy</td>
<td>2018</td>
<td>Implementation plan</td>
<td>N/A</td>
</tr>
<tr>
<td>REGDOC-3.2.1: Public Information and Disclosure</td>
<td>2018</td>
<td>Implementation plan</td>
<td>Implementation plan</td>
</tr>
</tbody>
</table>
Updates to Industry Standards Applicable to Class IB Facilities

<table>
<thead>
<tr>
<th>Standard</th>
<th>Publication</th>
<th>TRIUMF Status</th>
<th>CLSI Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>N286-12 <em>Management system requirements for nuclear facilities</em></td>
<td>2012</td>
<td>Implementation plan</td>
<td>Implemented Planned completion in 2018</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Planned inspection Q4 2018</td>
<td></td>
</tr>
</tbody>
</table>

CNSC staff continue to verify the implementation of the most recent updates
Conclusion

• Class IB accelerators operate safely
• All Class IB accelerator facilities were rated Satisfactory or Fully Satisfactory all 14 SCAs in 2017
• No radiological dose limit exceedances to the public or the workers
• Releases to the environment are well below regulatory limits and do not pose a risk to people or the environment
• Licensees have implemented corrective actions where required
• CNSC staff continue to provide regulatory oversight of the Class IB accelerator facilities in a risk-informed approach through:
  – inspections
  – review of licensee documents
  – effective implementation of CNSC’s regulatory framework
Overall Conclusion (1/2)

- CNSC staff spent 961 person-days on regulatory compliance activities, including 17 inspections over two years (2016-2017)
- CNSC staff’s compliance activities confirmed that:
  - Radiation protection programs at all facilities were adequate in controlling radiation exposures and keeping doses as low as reasonably achievable
  - No radiological dose limits exceeded for the public or workers
  - Environmental protection programs were effective
  - Conventional health and safety programs at all facilities continue to protect workers
- Performance of research reactors and Class IB accelerators were satisfactory to fully satisfactory in all 14 SCAs in 2017
Overall Conclusion (2/2)

CNSC staff continue to:

• provide regulatory compliance oversight to all licensed facilities to ensure that the facilities continue to make adequate provision to protect the health, safety and security of workers, Canadians and the environment

• ensure the implementation of Canada’s international obligations on the peaceful use of nuclear energy
Outline

- Background
- Regulatory Oversight
- Rating Objectives
- Rating Methodology for Nuclear Cycle Facilities
- Performance Reports
- Conclusion
Background (1/2)

- Regulatory Oversight Reports include performance ratings
- CNSC staff rate licensee performance within each Safety and Control Area
- Internationally Canada is unique in:
  - Rating performance for fuel cycle program licensees
  - Presenting these reports in a public meeting
  - Offering public interventions and participant funding on the reports
Background (2/2)

• Detailed reporting on areas of interest to the public and Commission:
  – Radiation Protection
  – Environmental Protection
  – Conventional Health and Safety

• Performance ratings reflect our understanding and history with the licensed facility
Licensee performance is continually assessed by CNSC staff
   - Performance ratings do not replace day to day compliance and enforcement
   - Non-compliances are addressed with enforcement actions at the time they are discovered

Compliance planning
   - Takes into account the risk associated with the type/complexity of the facilities or activities
   - Is flexible to allow for the broad range of licensee operations

Compliance results come from various inputs such as inspections, technical assessments of licensee scheduled and unscheduled reporting and enforcement actions
Regulatory Oversight (2/2)

• Subject Matter Experts are organized into Facility Assessment and Compliance (FAC) Teams
  – Licensing, inspection and specialist groups collaborate using a multi-key approach in regulatory oversight in teams organized by licensed facility
  – These teams participate in compliance planning and oversight activities throughout the licence period and reflect a collective knowledge of each facility

• Compliance activities include:
  – Inspections at the licensed locations
  – Technical assessments of licensee submissions such as:
    – scheduled Annual Compliance Reports
    – unscheduled event or occurrence reports
Rating Objectives

• Provides overall picture to the Commission, public and Aboriginal Groups on performance in a transparent manner

• Trending of ratings over time can inform regulatory program

• Indicate to licensees where they need to focus effort and where they need to maintain current performance

• Highlight good performance
Rating Methodology Overview (1/2)

• Expert judgement/qualitative approach in evaluating and rating licensees’ performance using performance indicators

• Based on evaluation of licensee’s performance:
  – Since the last rating was assigned
  – Over the current licensing period including the significance of any enforcement actions issued and the licensee’s response to those actions

• Ratings draw upon the FAC Teams’ exposure to rating similar facilities within that Safety and Control Area and ensure knowledge is shared

Rigorous Methodology and Reproducible Ratings
Each Safety and Control Area is evaluated individually and every facility has different inputs to the technical topic areas.

For example:

- A rating may not have an input from onsite inspections in an SCA if none were conducted in that year.
- In these cases the rating input is based on the FAC team’s assessment of scheduled and unscheduled reports since the last rating was assigned.

Each Safety and Control Area is Evaluated Individually
Three Step Process Approach

1. Identify Compliance Results
   • Inspections
   • Technical Assessments
     – Scheduled and
     – Unscheduled Reports
   • Enforcement actions
   • Trends
   • Performance indicators

2. Assess Compliance Results
   • Regulatory requirements

3. Rate Performance
   • Performance by SCA for each licensee
Identify Compliance Results

- Compliance results compiled by FAC Team
- The number and types of compliance results is facility specific and based on our risk-informed compliance plans
- Non-compliances are addressed as they are found and the Commission is updated on any significant findings at the time they occur
Assess Compliance Results

1. Use a qualitative, expert based approach to assess compliance results against regulatory requirements using documented technical assessments.
2. Safety significance is assigned to non-compliances and enforcement actions.
3. CNSC Regulatory Information Bank database used to rank, monitor and report on non-compliances and enforcement actions and licensee commitments.
Rate Performance (1/2)

1. Scheduled and Unscheduled Reporting
2. Inspection Results
3. Non-compliances and enforcement Actions
   - Low, medium and high safety significance

Rate Performance

4. Performance Indicators and Trends
   - Lost-time injuries
   - Reportable events
   - Licensee response to events
   - Worker radiation doses
   - Environmental releases
   - Major improvements

FAC Team Considerations in Rating Performance
• Qualitative approach taken due to the number of compliance results considered for these licensees
• Consistency in rating between facilities and activities through FAC Teams’ shared knowledge, lessons learned and mentoring
• Single reportable event or deficiency in a program area does not result in a licensee getting a BE or prevent a licensee from getting a FS
• Compliance results drive the rating in an SCA
Example 1: TRIUMF 2016 Waste Management SCA Rating

1. Identify Compliance Results
   - Inspections
     - Type II Inspection with focus on Waste Management SCA
   - Technical Assessments
     - Annual Compliance Report review

2. Assess Compliance Results
   - Inconsistent implementation of waste management program across site
     - Incomplete inventory of radioactive and hazardous wastes for all storage areas on site
     - Insufficient access control for some waste storage areas
     - Some radioactive waste containers not labelled
     - Lack of secondary containment for liquid wastes

3. Rate Performance
   - Enforcement Actions
     - 1 Directive
     - 4 Action Notices
     - Medium safety significance
       - Inconsistencies and gaps for lower risk waste materials
     - Generally well implemented program for high activity radioactive waste and/or very hazardous substances
Example 2: TRIUMF 2017 Waste Management SCA Rating

1. Identify Compliance Results
   - Inspections
     - Type II Inspection with focus on Waste Management SCA
   - Technical Assessments
     - Annual Compliance Report review

2. Assess Compliance Results
   - All previous Enforcement Actions fully addressed
     - No new non-compliances observed
     - Significant improvements over previous inspection findings

3. Rate Performance
   - Enforcement Actions
     - NONE
   - Recommendations
     - 2 of 4 related to improving the inventory system

UA | BE | SA | FS

1. Identify Compliance Results
   - Type II inspections in Security SCA
   - Technical Assessments
   - Annual Compliance Report review

2. Assess Compliance Results
   - Reactor converted from HEU to LEU in 2008 but security level was maintained (suitable for category II nuclear material)
   - No non-compliances observed
   - Good practices recognized
   - Meet or exceed security requirements
   - IPPAS mission recommendations addressed quickly and closed

3. Rate Performance

   Enforcement Actions
   - NONE
   Good practices recognized
   - IPPAS mission
   - relationship with local law enforcement

UA  BE  SA  FS
Conclusion

- Performance ratings utilize a qualitative, expert based approach that takes into consideration the wide variety of licences and relative risk ranking associated with the type of activity and associated hazards.

- While the approach is qualitative, it is comprehensive, based on expert opinion and includes operational staff, subject matter experts and management to arrive at performance ratings.
ANNEX 2

Commission Meeting, August 22-23, 2018
CMD 18-M32.A

INSPECTION REPORTS FOR 2016 – 2017
# Inspection Reports – Research Reactors

<table>
<thead>
<tr>
<th>Licensee</th>
<th>Report number</th>
<th>Inspection date</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Alberta</td>
<td>NLRRD-UASF-16-T2-(08-03)</td>
<td>3/08/2016</td>
</tr>
<tr>
<td>Saskatchewan Research Council</td>
<td>SRC-2016-01</td>
<td>4/08/2016</td>
</tr>
<tr>
<td>Royal Military College</td>
<td>RMCC-SLWPK-2016-01</td>
<td>27/09/2016</td>
</tr>
<tr>
<td>McMaster Nuclear Reactor</td>
<td>MNR-2016-01</td>
<td>28/07/2016</td>
</tr>
<tr>
<td>University of Alberta</td>
<td>UoA-SLWPK-2017-01</td>
<td>3/10/2017</td>
</tr>
<tr>
<td>McMaster Nuclear Reactor</td>
<td>MNR-2017-01</td>
<td>23/11/2017</td>
</tr>
<tr>
<td>Saskatchewan Research Council</td>
<td>SRC-SLWPK-2017-01</td>
<td>23/11/2017</td>
</tr>
<tr>
<td>Ecole Polytechnique de Montreal</td>
<td>EPM-2017-01</td>
<td>7/12/2017</td>
</tr>
<tr>
<td>Royal Military College</td>
<td>RMCC-SLWPK-2017-01</td>
<td>13/12/2017</td>
</tr>
</tbody>
</table>
## Inspection Reports – Class IB Facilities

<table>
<thead>
<tr>
<th>Licensee</th>
<th>Report number/Area of inspection</th>
<th>Inspection date</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIUMF</td>
<td>ACFD-TRIUMF-2016-02-11</td>
<td>9/02/2016</td>
</tr>
<tr>
<td>TRIUMF</td>
<td>ACFD-TRIUMF-2016-06-07</td>
<td>7/06/2016</td>
</tr>
<tr>
<td>TRIUMF</td>
<td>ACFD-TRIUMF-2016-10-27</td>
<td>25/10/2016</td>
</tr>
<tr>
<td>TRIUMF</td>
<td>ACFD-TRIUMF-2017-02-03</td>
<td>30/01/2017</td>
</tr>
<tr>
<td>TRIUMF</td>
<td>ACFD-TRIUMF-2017-10-26</td>
<td>24/10/2017</td>
</tr>
<tr>
<td>CLS</td>
<td>Inspection of: Management System</td>
<td>26/01/2016</td>
</tr>
<tr>
<td>CLS</td>
<td>Inspection of: Human Performance Management</td>
<td>24/01/2017</td>
</tr>
<tr>
<td>CLS</td>
<td>Inspection of: Environmental Protection, Conventional Health and Safety</td>
<td>25/07/2017</td>
</tr>
</tbody>
</table>