Regulatory Experience and Developments Related to Accelerator Isotope Production

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nuclearsafety.gc.ca
Established May 2000, under the **Nuclear Safety and Control Act (NSCA)**

Replaced the AECB of the 1946 **Atomic Energy Control Act**

**Celebrating 66 years of nuclear safety!**
Our Mission Is Clear

protect the health, safety and security of Canadians and the environment; and to implement Canada’s international commitments on the peaceful use of nuclear energy

Canada’s nuclear watchdog

Canadian Nuclear Safety Commission
CNSC Regulates All Nuclear-Related Facilities and Activities

Nuclear fuel cycle
- Uranium mines and mills
- Uranium fuel fabricators & processing
- Nuclear power plants
- Waste management facilities

Other facilities and activities
- Nuclear substance processing
- Industrial and medical applications of nuclear substances
- Research and educational facilities
- Export/import of controlled nuclear substances, equipment and technology

...From Cradle To Grave
Including Particle Accelerators

High Energy above 50 MeV (Class I)

Lower Energy (Class II)
Class II Nuclear Facilities in Canada

- **Medical**: 86%
  - Linear accelerator
- **Industrial**: 6%
  - Pool irradiator
- **Research**: 8%
  - Pelletron

**Licences**:
- **47 Licensees**
- **65 Sites**
- **300 Licences**
Medical Isotope Shortage and Government Response

- Medical Isotope Shortage after extended shutdown of NRU reactor 2008 - 2009
- Government initiatives to secure supply and develop alternatives
  - Expert Review Panel
  - NISP and ITAP
Expert Review Panel on Medical Isotope Production

- 4 experts blue ribbon panel
- Main recommendations
  - Diversity and redundancy
  - Multi-use infrastructure
  - Discourage reliance on reactor and HEU solutions
  - Support Research and development for cyclotrons and high power linacs
Government of Canada's Action on our Medical Isotopes Supply

A medical isotope is a safe radioactive substance used by health professionals to assist in the diagnosis or treatment of health conditions of the heart, the circulatory system, and other organs.

These isotopes are mainly manufactured at government-owned government facilities, to ensure the safe, reliable and continuous supply of nuclear medicine to Canadian patients. The medical isotopes produced in Canada are used in nuclear medicine procedures in hospitals across the country.

$35M government funding for two years
4 projects: 2 cyclotrons and 2 linear accelerators
Two Methods

Indirect Electron Linac

Direct Proton Cyclotron
Area of Research

- Target and converter design and optimization
- Cooling capacity
- Target processing and achievable yield
- Generator design and optimization
- Mo-100 costs, availability and recycling
- Overall process optimization, including yield optimizations
- Work to address product regulatory requirements
More Cyclotrons for Isotope Production

- **In operation:** 18
- **Under construction:** 2
New Facility - Example

35 MeV electron linac at Canadian Light Source Inc. Saskatoon, Saskatchewan
New Facility - Example

24 MeV Proton Cyclotron at Centre hospitalier universitaire de Sherbrooke, Sherbrooke, Québec

Courtesy of CHUS

Advanced Cyclotron System's TR2.4 cyclotron is delivered to Sherbrooke University Hospital. Courtesy of CHUS

Radioactive medicine without the nuclear headache

BY IAN BROWN
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“Conventional” Safety Features

- Door Interlock
- Pre-irradiation alarm
- Beam On Light
- Ion Source
- Acceleration
- Target
- Emergency Stop
- "Prompt" Radiation
- LPO or "Search Switch"
“New” Hazards

With isotope production
- Higher beam intensities
- Creation of dispersible radioactivity
- Radioactive material processing

Need more attention to
- Shielding
- Residual Activation
- Contamination Control
- Nuclear Ventilation
Lessons Learned - Examples

Stack not high enough

Nuclear Ventilation Stack
Lessons Learned - Examples

Target not cooled enough
Monte Carlo shielding calculations not detailed enough: Trenches not modelled
What Is Safety Culture?

Safety Culture is that part of an organization’s culture that determines its general readiness to act safely.

It cuts across all level and all aspects of an organization's performance.
“Safety culture refers to the characteristics of the work environment, such as the values, rules, and common understandings that influence employees’ perceptions and attitudes about the importance that the organization places on safety.” (CNSC definition from RD-337 / RD-367)
Safety Culture and Management System

Visibility

Artifacts

Espoused Values

Basic assumptions

Not visible

Management System

Safety Culture
Thank You

Any Questions?

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