



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

Regulatory Experience and Developments Related to Accelerator Isotope Production

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nuclearsafety.gc.ca

Canadian Nuclear Safety Commission



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!***



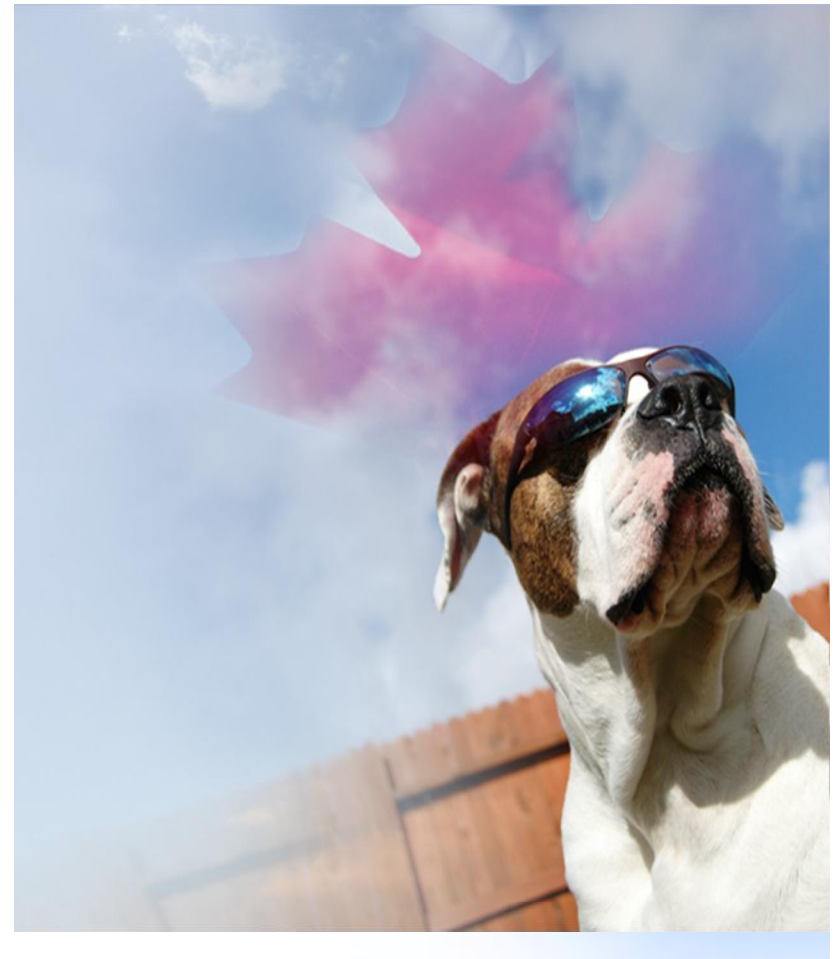
Our Mission Is Clear



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

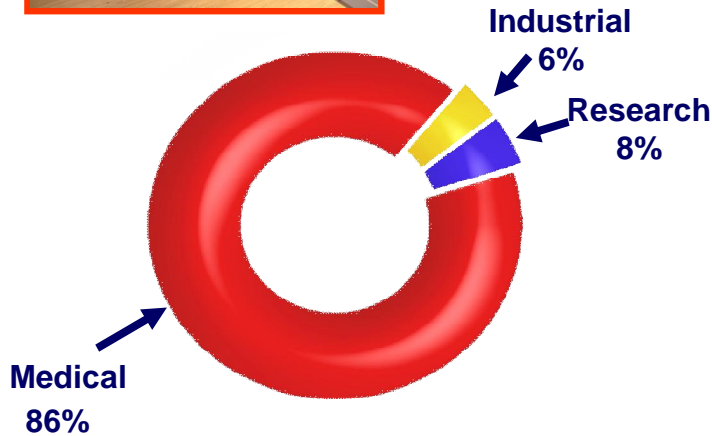


Medical

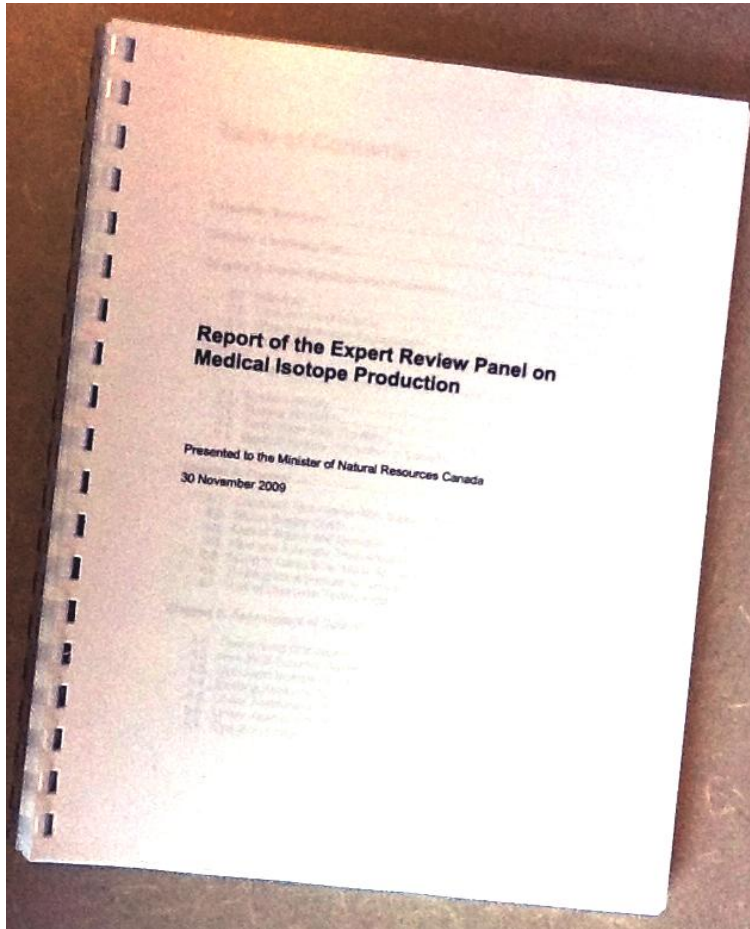


Industrial

Research



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

Non-reactor-based Isotope Supply Contribution Program (NISCP)



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> Government of Canada's Action on our Medical Isotopes Supply

Energy Sector
Energy Home
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Energy Policy
Energy Sources
Natural Gas
Petroleum Products and Crude Oil Prices
Petroleum Products Market
Crude Oil Market
Infrastructure for

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 and treatment of health conditions of the heart, the circulatory system and other organs.

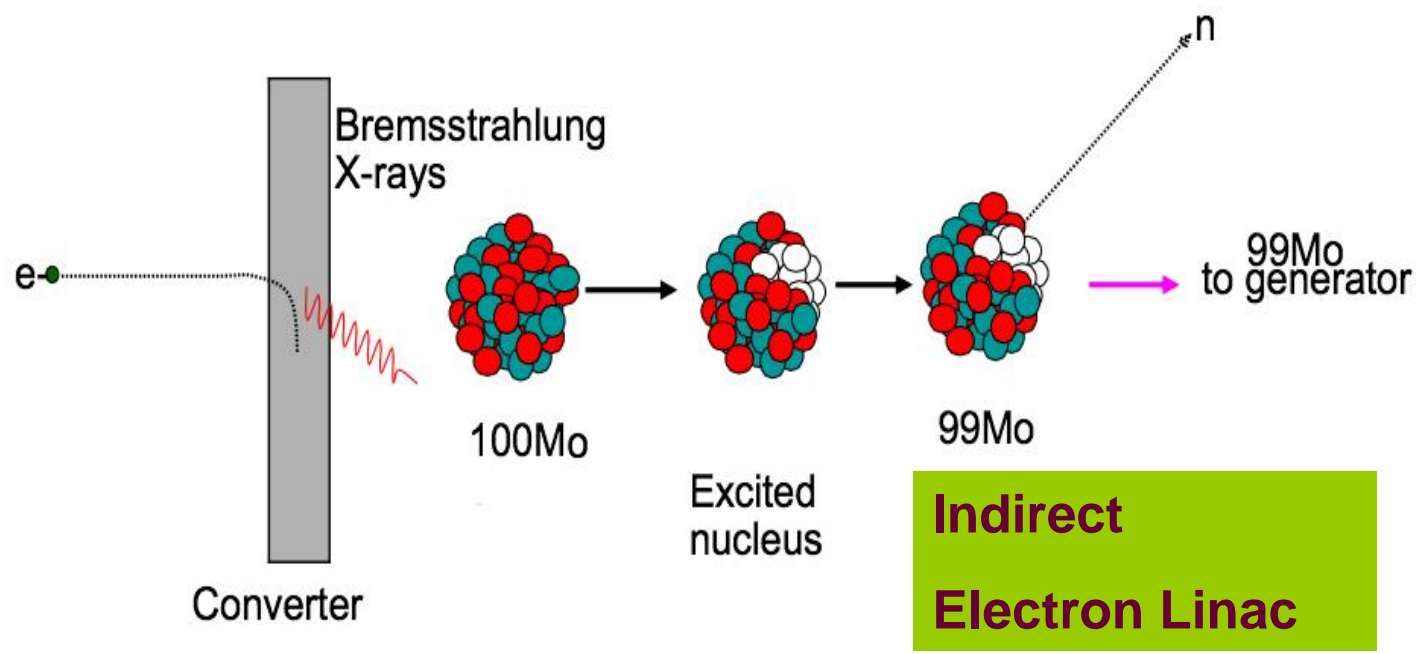
These isotopes are mainly produced by the government-owned Atomic Energy of Canada Ltd. (AECL) at its nuclear reactor (NRU) in Chalk River, Ontario. Other isotopes are produced by medical cyclotrons and linear accelerators.

About Us
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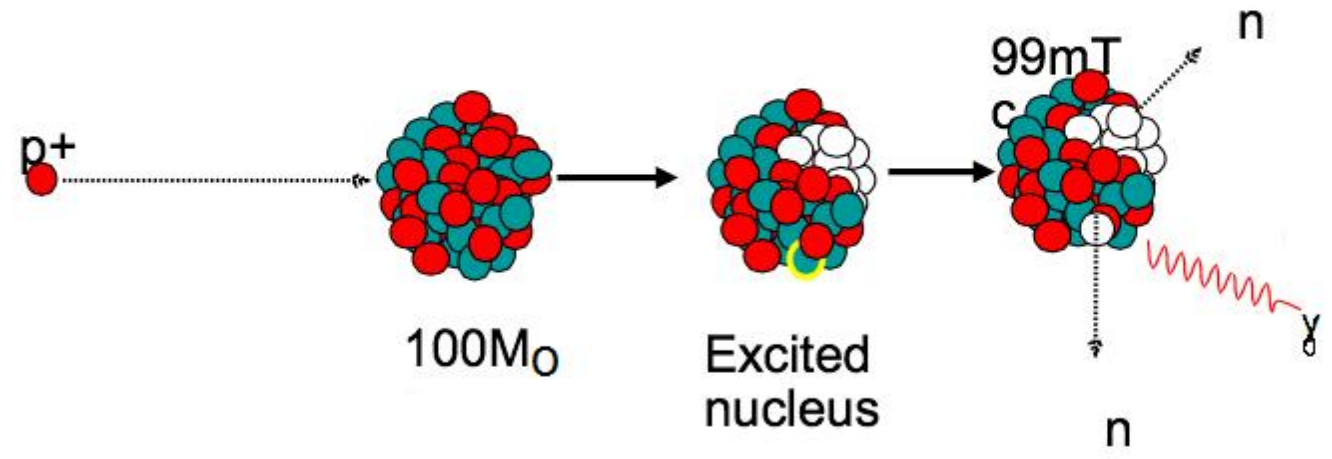
Uranium / Nuclear Energy
Uranium
Nuclear Energy
Radioactive Waste
Medical Isotopes

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

Two Methods



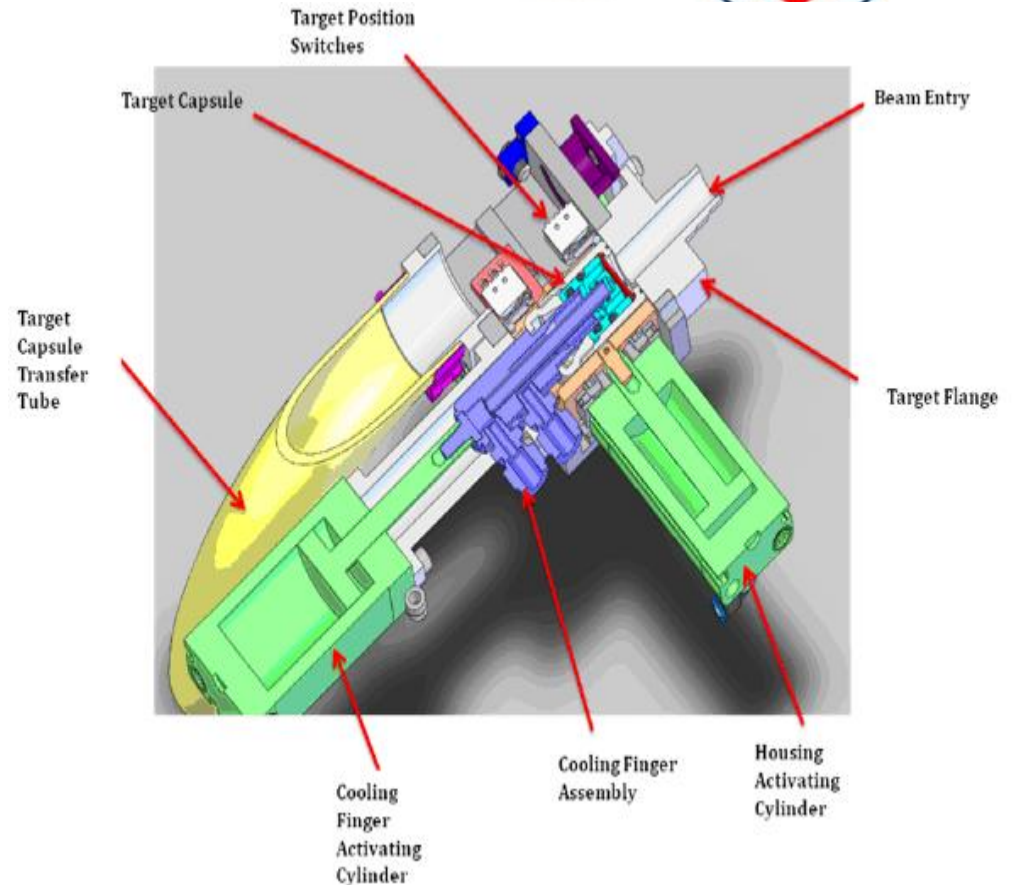
Direct Proton Cyclotron



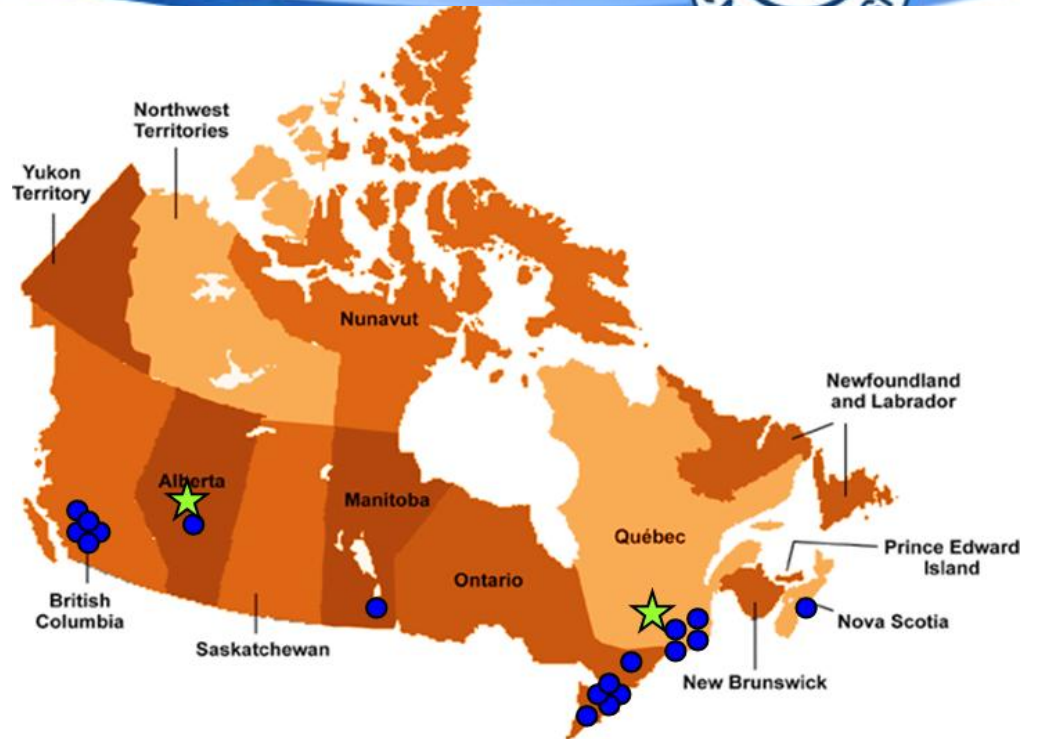
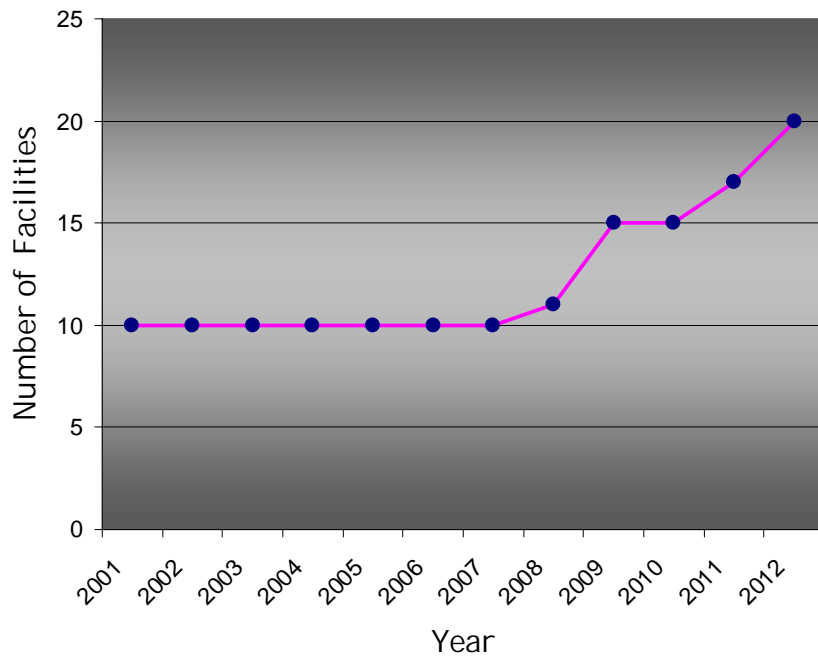
Area of Research



- 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



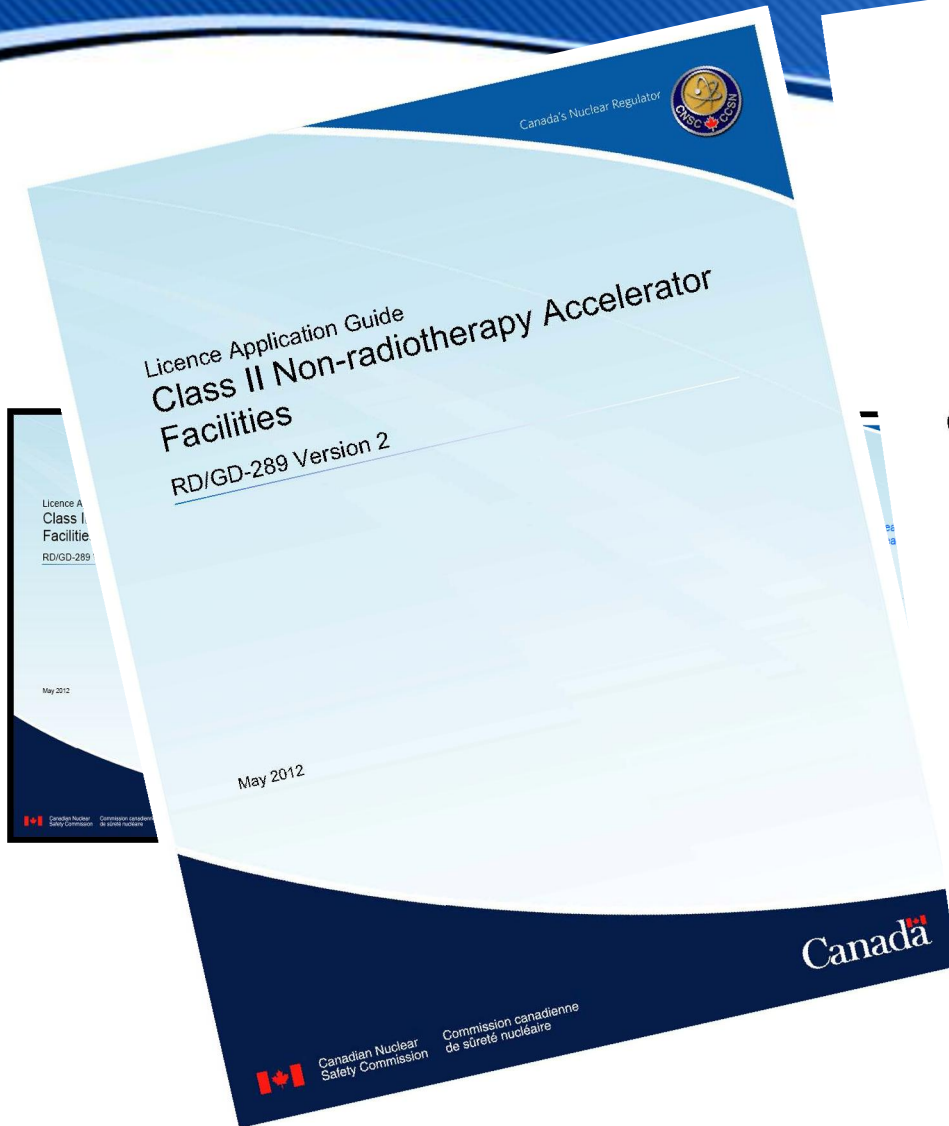
More Cyclotrons for Isotope Production



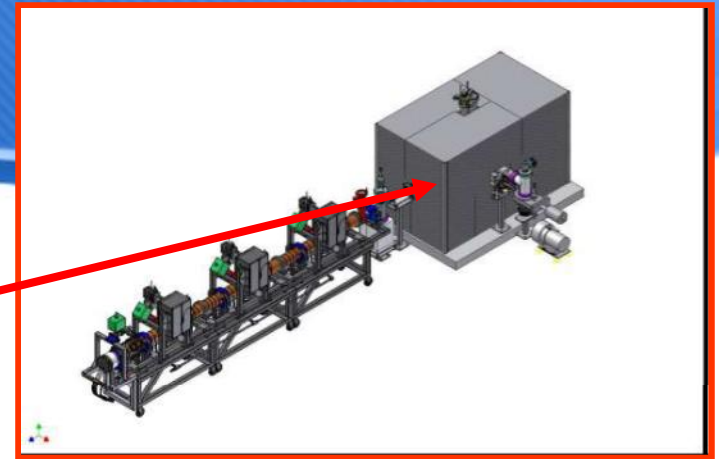
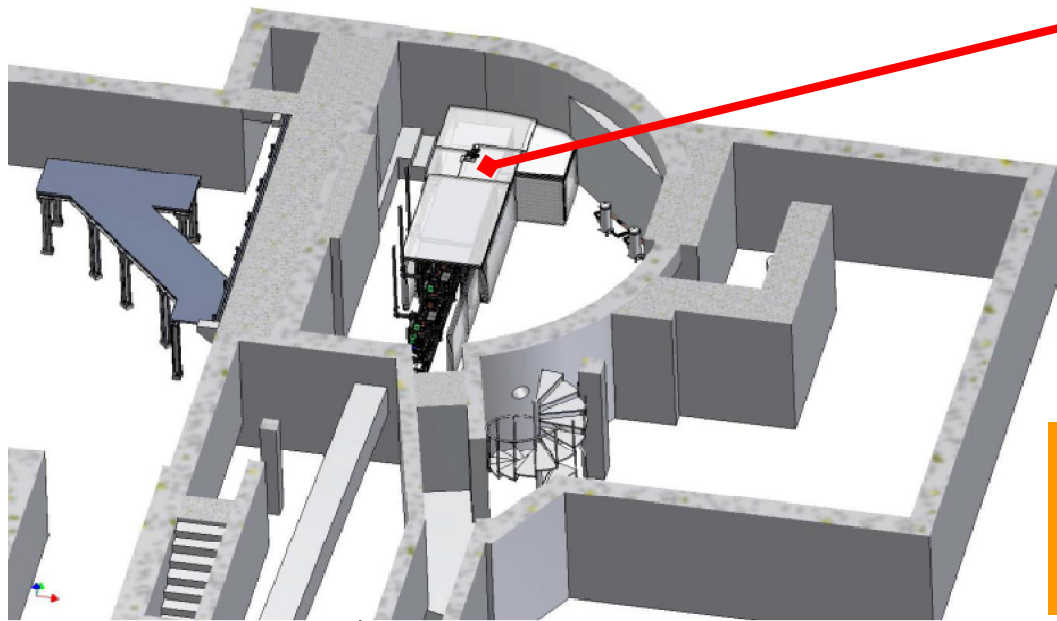
● In operation: 18

★ Under construction: 2

Regulatory Instruments

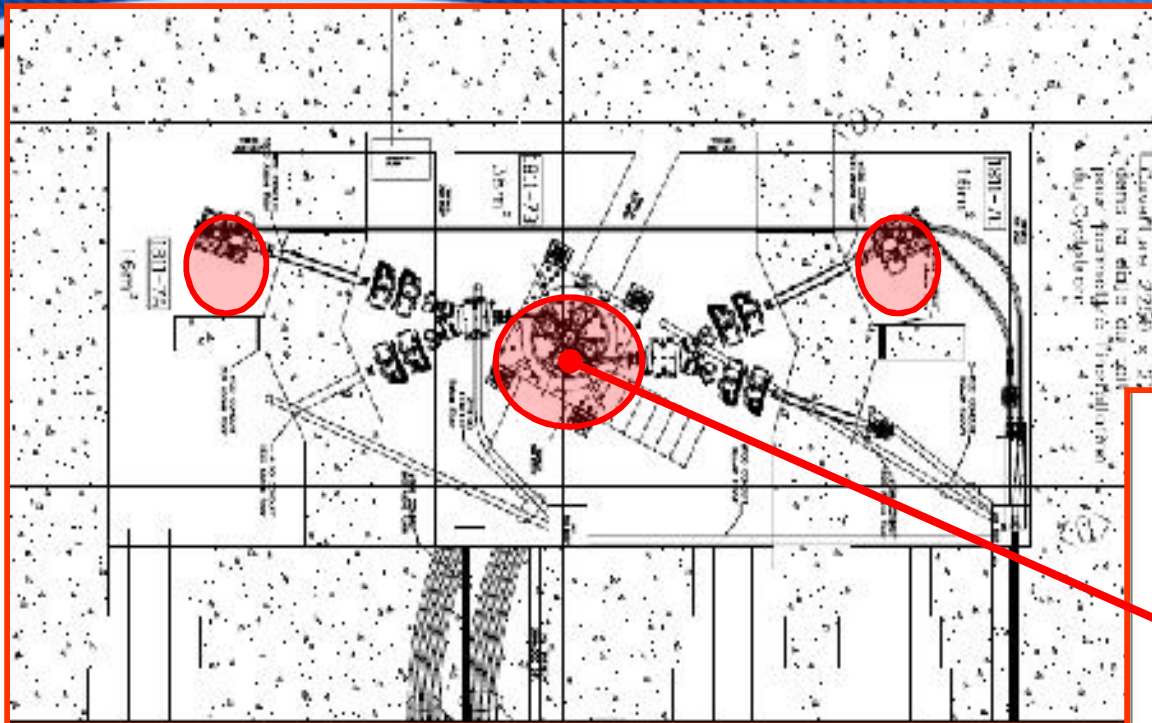


New Facility - Example



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

THE GLOBE AND MAIL



Advanced Cyclotron Systems's TR24 cyclotron is delivered to Sherbrooke Uni

Courtesy of CHUS

DISCOVERIES

Radioactive medicine without the nuclear headache

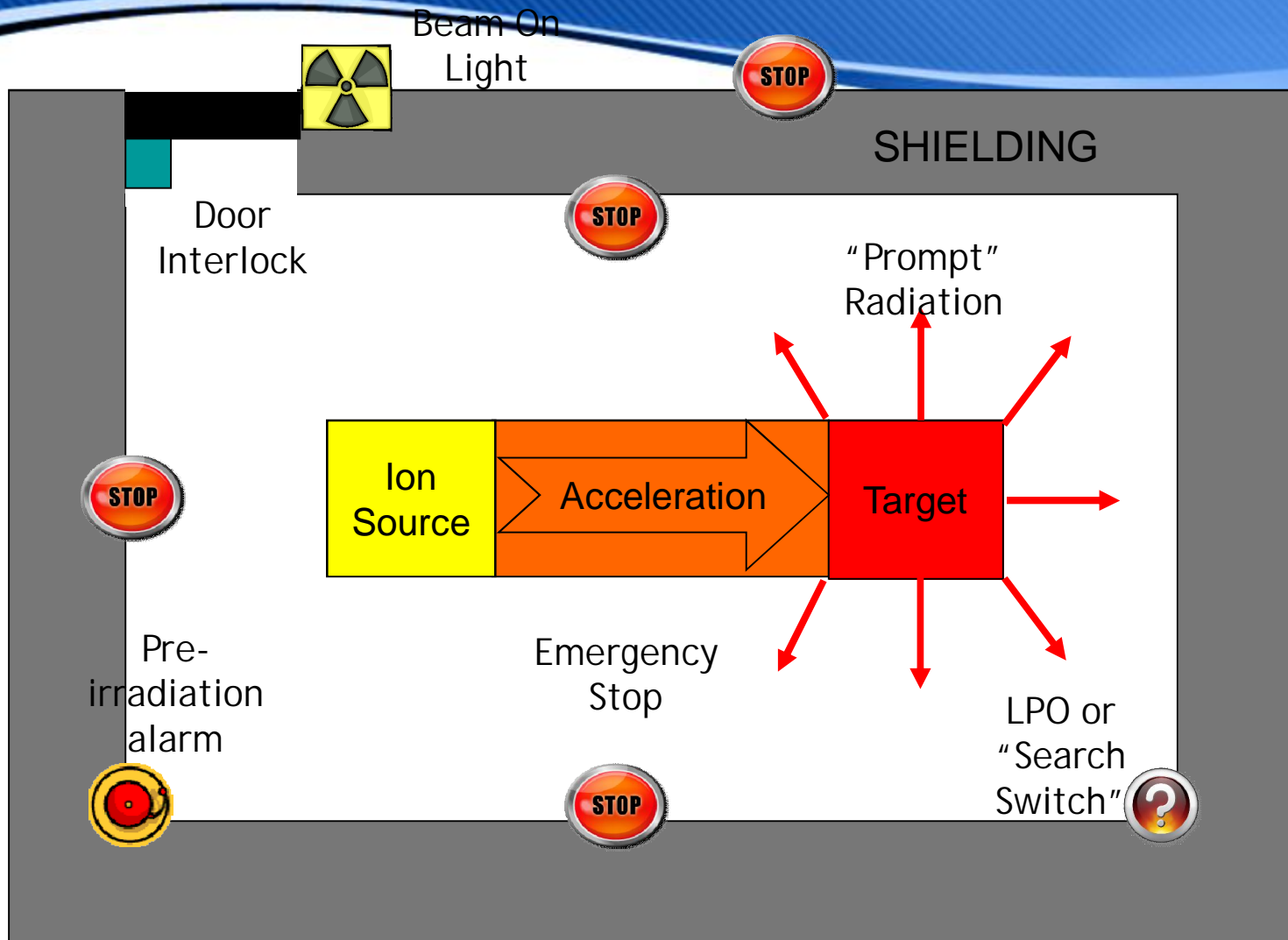
HANNAH HOAG

Globe and Mail Update

Published Friday, Jan. 20, 2012 4:16PM EST

Last updated Monday, Feb. 20, 2012 9:28PM EST

“Conventional” Safety Features



“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

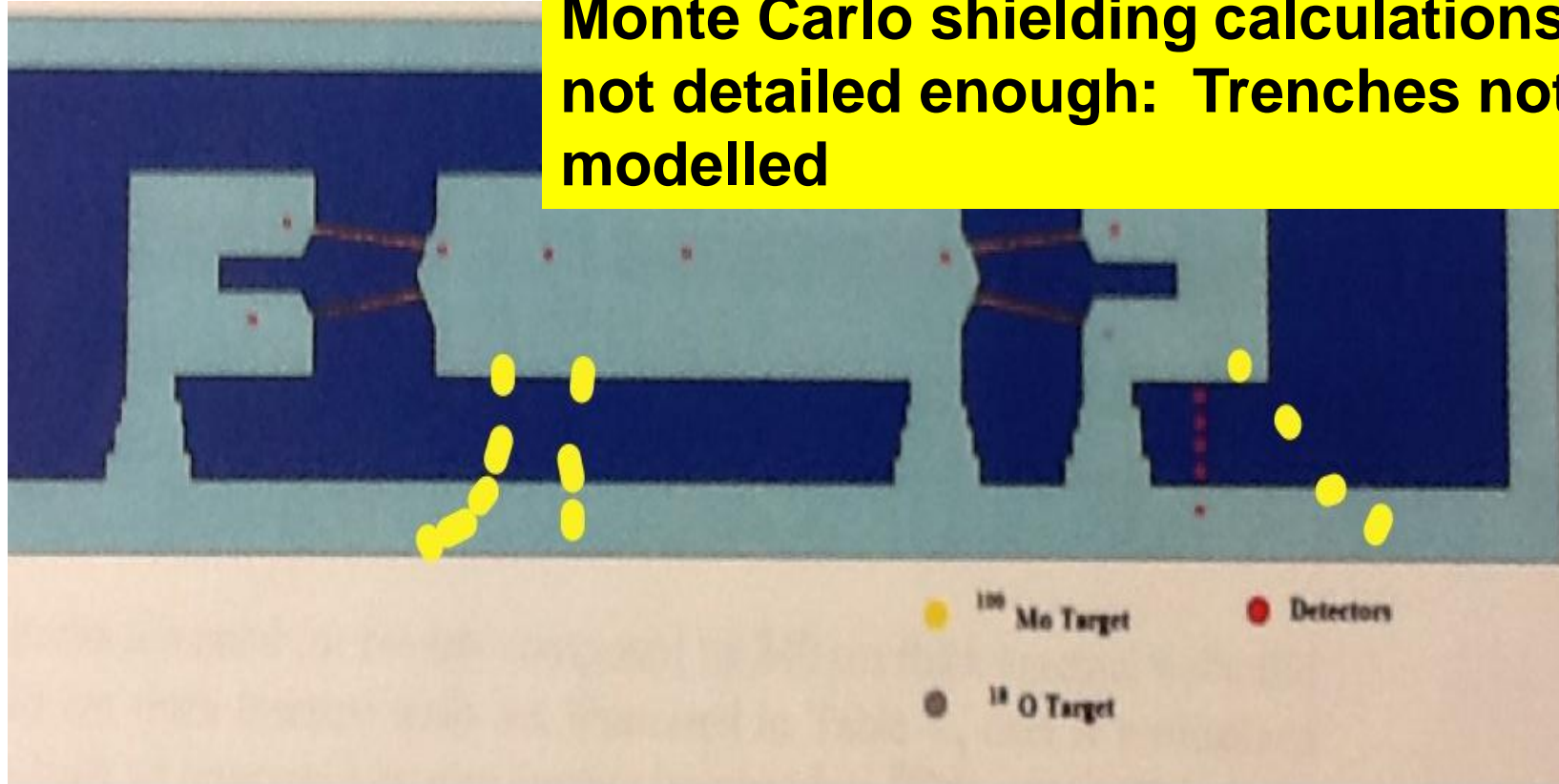


Target not cooled enough

Lessons Learned - Examples



Monte Carlo shielding calculations not detailed enough: Trenches not modelled

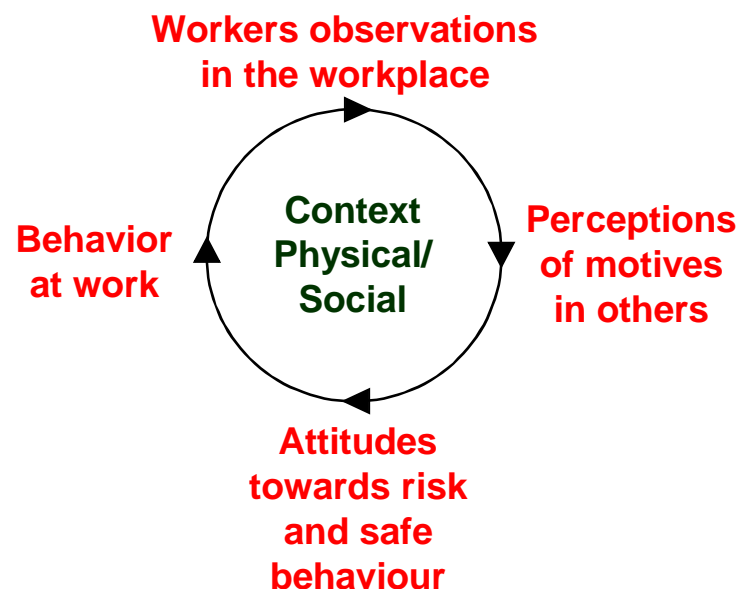


What Is Safety Culture?



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.

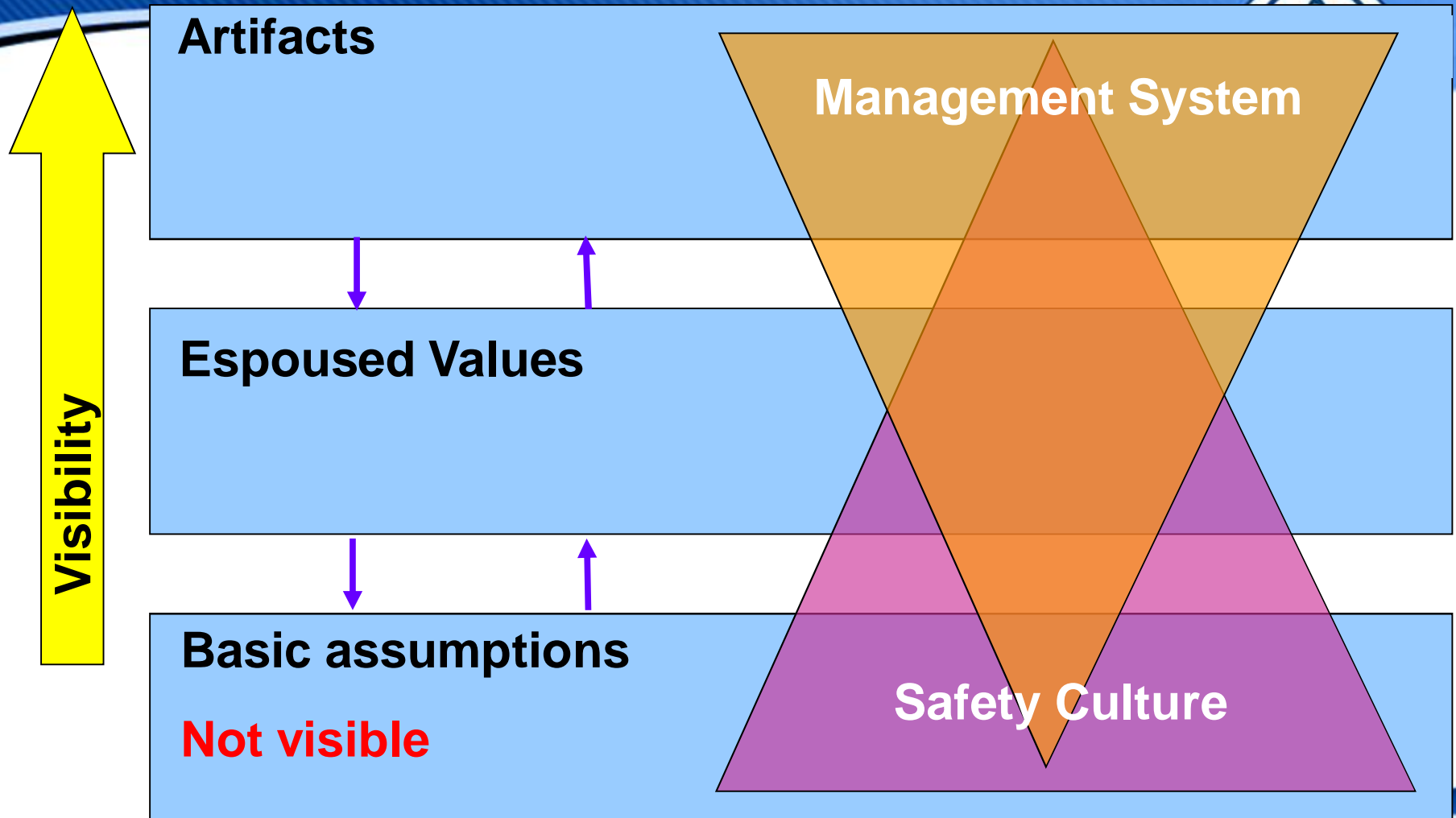


More Formal Definition



“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





Thank You

Any Questions?

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