



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire



The Tritium Studies Project: A focus on health

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Presentation overview



- Introduction and scope of charter
- Individual studies
- Health effects, dosimetry and radiological protection of tritium
- Public involvement

Introduction and scope



- In January 2007, the CNSC Tribunal directed staff to initiate research studies on tritium
- In response, the CNSC undertook several research projects as part of the Tritium Studies Project
 - The goal of this research was to expand the body of knowledge on tritium and to identify opportunities to further enhance regulatory oversight of tritium-related activities in Canada

Individual studies



The Tritium Studies Project consists of several studies:

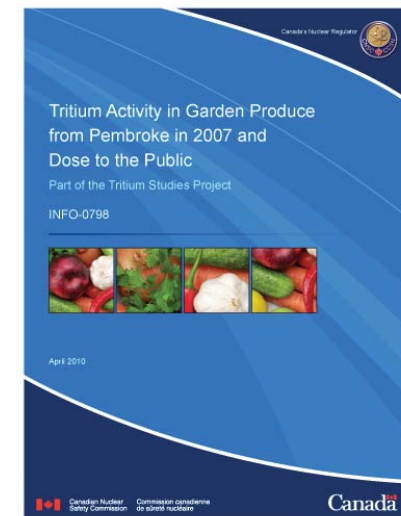
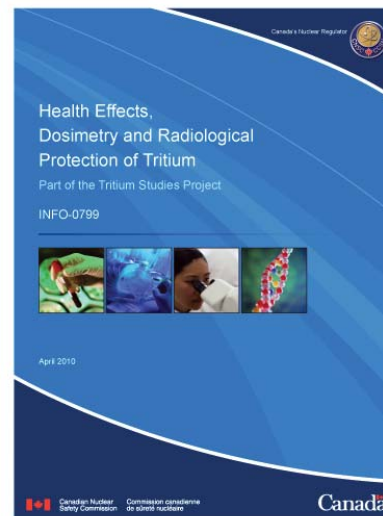
- Standards and Guidelines for Tritium in Drinking Water
- Tritium Releases and Dose Consequences in Canada in 2006
- Investigation of the Environmental Fate of Tritium in the Atmosphere
- Evaluation of Facilities Handling Tritium



Individual studies (continued)



- Health Effects, Dosimetry and Radiological Protection of Tritium
- Tritium in Garden Produce from Pembroke in 2005 and 2007
- Tritium in Soils and Vegetation



Health effects, dosimetry and radiological protection of tritium

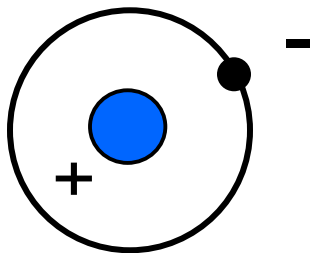


- Physical and chemical properties of tritium
- Health effects of tritium
 - Laboratory studies
 - Epidemiology studies
- Relative biological effectiveness (RBE) of tritium
- Dosimetry of tritium
- Options for assessing and controlling risk

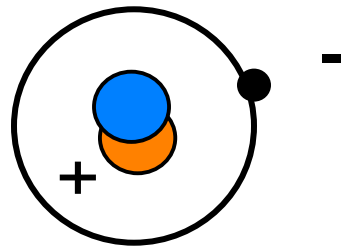
Physical and chemical properties of tritium



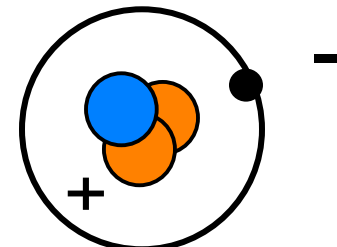
- What is tritium?
 - Radioactive hydrogen
 - 2 neutrons and 1 proton



Hydrogen
(H-1)



Deuterium
(H-2)



Tritium
(H-3)

- All have essentially the same physical and chemical properties and characteristics

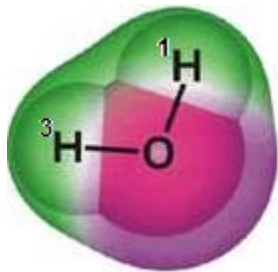
Physical and chemical properties of tritium



- Tritium is typically found in the form of HTO or OBT

HTO Model

Compounds that behave as water after being taken into the body



OBT Model

Compounds that behave as carbon after being taken into the body



Health effects of tritium: Laboratory studies



Main Findings

- No observed health effects below ~1 GBq / gram of body weight in mice

Administered Dose (GBq/g BW/d)	Dose (mSv)	Effect (Laboratory animals)
< 1	–	No effect
> 1	500	-cancer promotion -embryo/foetus development -genetic/reproductive -cell death

Health effects of tritium: Epidemiology studies



Main Findings

- To date, the existing information does not contain enough detail to estimate the health risks of tritium exposure specifically
- The risk to workers, offspring and the general public from all CNSC licensed radiation sources is low. Tritium exposures represent a fraction of total radiation sources, thus tritium risk is only a fraction of total risk, which is low



Conclusion

- Based on both lines of evidence—epidemiology studies and laboratory studies—adverse health effects due to tritium exposure at the current exposure levels in Canada are highly unlikely

Relative biological effectiveness of tritium



Main Findings

Reference Radiation	RBE
X-ray	1.4
Gamma ray*	2.2

*Preference in literature

Conclusion

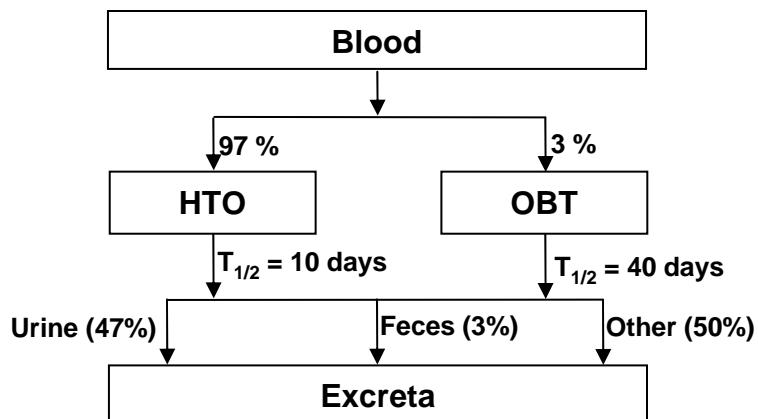
- Tritium beta radiation is about 1.4 times more biologically effective than 250 kVp X-rays and 2.2 times compared to gamma rays

Dosimetry of tritium

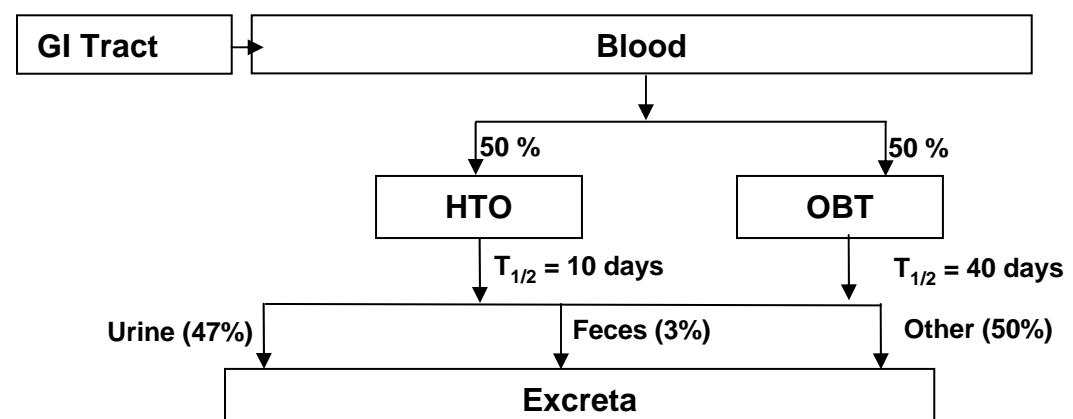


The ICRP recommends two main models to calculate the dose from tritiated compounds based on the intake pathway:

ICRP HTO Model



ICRP OBT Model



Dosimetry of tritium



Conclusions

- In general current ICRP models are reasonably consistent with experimental results, but uncertainties exist on:
 - The contribution of HT lung dose to the total effective dose from HT intakes, and
 - Dose from dietary intakes of OBT, given recent physiological models and their applicability to adults only
- Current dosimetry and biokinetic models for assessing dose are acceptable for radiation protection purposes

Options for assessing and controlling the risk



Using a different w_R for tritium to reflect the RBE value would best reflect the radiation risk from tritium

However it is important to consider that:

- There are no other isotope-specific w_R values
- It would be difficult to compare radiation protection practices nationally and internationally
- There are many other uncertainties due to other significant variables.

Overall study conclusions



- Based on both lines of evidence, epidemiology and laboratory studies, adverse health effects due to tritium exposure at the current exposure levels in Canada are highly unlikely
- The results of over 50 experimental studies related to the determination of a single RBE value for tritium confirm that tritium beta radiation is about 1.4 times more biologically effective than radiation from 250 kVp X-rays and 2.2 times more biologically effective than gamma ray radiation
- Current dosimetry and biokinetic models for assessing dose are acceptable for radiation protection purposes
- Canada's current regulatory framework is satisfactory for controlling tritium exposures

Public involvement



- Keeping the public informed about effects of tritium from CNSC-licensed facilities is a key part of the CNSC's mandate
- This information session was organized to give members of the public and stakeholders an overview of each of the tritium studies and an opportunity to speak directly with the staff
- Members of the public will have the opportunity to intervene in writing on the Tritium Studies Project Commission Meeting, currently scheduled for either June 16 or 17, 2010



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