Information
BULLETIN
d'Information

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Cyclotron production of Fluorine-18 (F-18) and the presence of tritium (H-3): What you need to know about handling, recycling and disposing of tritium in enriched water.

Are you aware that H-3 is produced during the F-18 production?

F-18 is the most successful and widely used imaging agent in positron emission tomography (PET) today. A competitive reaction ^{18}O (p, ^{3}H)^{16}O occurs coincidentally during the production of F-18[1,2].

How much H-3 is produced? Is a licence required?

Since 2015, the Canadian Nuclear Safety Commission (CNSC) started sampling enriched water ($H_2{}^{18}O$) used in cyclotron PET facilities to establish the amount of H-3 produced during normal operational conditions. The irradiated $H_2{}^{18}O$ samples analyzed by the CNSC indicate insufficient total activity of H-3 to require a licence.

Are there other regulatory implications?

Licensees should consider the following when producing F-18:

- Know how much H-3 is produced during routine operation, quantify and label recovered irradiated $H_2{}^{18}O$.
- Keep a record of H-3 concentration on all transactions.
- If disposal of $H_2{}^{18}O$ is chose, ensure H-3 concentration does not exceed the exemption quantity [1 MBq/mL]

After each irradiation, H-3 concentration increases, requiring additional measures to handle the H-3 in $H_2{}^{18}O$. As the half-life of H-3 is 12.3 years, the total activity will accumulate in $H_2{}^{18}O$ and will eventually trigger the need for a licence to possess, store and handle the isotope.

Is H-3 removed when the $H_2{}^{18}O$ is recycled by the suppliers?

Not necessarily. The CNSC laboratory also analyzed samples of nominally "virgin" $H_2{}^{18}O$. The H-3 concentration in some samples demonstrated higher than normal background levels, presumably as a result of suppliers recycling returned $H_2{}^{18}O$, ergo H-3 is not always removed. As such, licensees should measure the total H-3 activity in any new stock of $H_2{}^{18}O$ and whenever there is a change during the routine operation of F-18 production and notify the CNSC if the H-3 concentration is above its exemption quantity, that is, 1 MBq/mL.

The CNSC will continue sampling $H_2{}^{18}O$ in the cyclotron PET facilities across Canada to measure H-3 concentrations.

[1] A. Licea, N. St-Amant, Tritium Production – Competitive Reaction in Cyclotrons F-18 Productions and Regulatory Implications, SATIF-13, Workshop Proceedings, Dresden, Germany, 11-13 October 2016, Nuclear Energy Agency

[2] Marshall et al., Quantification of the activity of tritium produced during the routine synthesis of ^{18}F fluorodeoxyglucose for positron emission tomography Journal of Radiological Protection, 34 (2014), 435-444.

For additional information, contact your Project Officer
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