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Atomic Energy Control Board

Commission de contrôle de l'énergie atomique

REGULATORY DOCUMENT R-100

Regulatory Policy Statement

THE DETERMINATION OF EFFECTIVE DOSES FROM THE INTAKE OF TRITIATED WATER

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Canada

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6. The Atomic Energy Control Board may be contacted as follows:

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THE DETERMINATION OF EFFECTIVE DOSES
FROM THE INTAKE OF TRITIATED WATER

1. BACKGROUND

To comply with the regulatory requirements relating to the dose from exposures to tritiated water (HTO), Atomic Energy Control Board (AECB) licensees currently measure tritium concentration in urine to determine whole body dose. This approach has been based on the consideration that the time-integrated tritium concentration (which is proportional to accumulated dose) in any organ or tissue would not exceed that in the body water. Hence the doses estimated from urine concentrations are always conservative.

The International Commission on Radiological Protection (ICRP) recommends that the average soft tissue dose be used to determine effective dose equivalents for HTO exposures. The ICRP also recommends that only the retention in body water be considered when committed doses from HTO exposures are calculated; this recommendation is based on the consideration that the errors introduced by neglecting the long-lived tritium component (those tritium atoms retained in organic molecules of the body cells) are small (only of the order of 10% of the committed dose equivalent to the whole body).

The ICRP recommendations have been reviewed by:

(a) AECB staff,

(b) some licensees involved in the use of tritiated water, and

(c) the Federal-Provincial Working Group on Bioassay and In Vivo Monitoring Criteria*.

The Federal-Provincial Working Group has recommended that a better estimate of the average soft tissue dose can be obtained from urine concentrations if the organically-bound tritium is included in the calculation. This recommendation is based on work done at Chalk River Nuclear Laboratories which has shown that the average soft tissue dose from HTO exposures can be estimated from urine concentration measurements by the use of a modifying factor.

The differences between the methods of determination stem from the fact that for Reference Man, total body water is 42 kg, but the mass of soft tissue over which the dose is distributed is 63 kg. In addition, the non-aqueous component of soft tissue contains organically-bound tritium at a concentration of 20% of that in body water.

The current method is to assume that the tritium dose is delivered only to the 42 kg of body water. ICRP recommends that the 63 kg of soft tissue should be considered the target, which would reduce the dose by a factor of $\frac{42}{63}$ or 0.67.

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* This Working Group was formed under the auspices of the Federal-Provincial Conference of Deputy Ministers of Health, through the Advisory Committee on Environmental and Occupational Health and the Subcommittee on Radiation Surveillance.

The Federal-Provincial Working Group approach is to take account of the organically-bound tritium, which leads to a reduction factor of 0.73. Details of this calculation may be found in Reference 3.

The draft document of the Federal-Provincial Working Group was sent for review to Canadian universities, senior staff of all provincial governments, the Canadian Association of Physicists, the Canadian Association of Nuclear Medicine, the senior health physics staff of all Canadian nuclear utilities, Atomic Energy of Canada Limited, and some members of the AECB Advisory Committee on Radiological Protection.

The comments received were discussed by the Working Group and incorporated into the document where appropriate. This document has now been published by Health and Welfare Canada.

The AECB concludes that the ICRP recommended method of determining the committed dose equivalent to soft tissues of the body arising from an intake of tritiated water can be improved by including the organically-bound tritium in the calculation. Furthermore, representatives of all the utilities, the Bureau of Radiation and Medical Devices of Health and Welfare Canada and the Chalk River Nuclear Laboratories have agreed to use the procedure recommended by the Federal-Provincial Working Group on Bioassay.

Licensees are cautioned, however, that the Federal-Provincial Bioassay Guideline is based on the ICRP system of dose limitation and does not contain quarterly limits, as required by the Atomic Energy Control Regulations. The derived action level in the guidelines for tritium bioassay, by means of which decisions are to be made on the significance of urinalysis results, is based on an annual dose and, therefore, must be modified if compliance with the quarterly limit is to be demonstrated.

The AECB position is presented in the following policy statement.

2. POLICY STATEMENT

2.1 Preamble

The ICRP recommendation for the determination of effective doses from the intake of tritiated water by measuring tritium concentration in urine has been reviewed by AECB staff, in cooperation with some licensees, universities, and provincial authorities. It has also been reviewed by the Federal-Provincial Working Group on Bioassay in the course of the preparation of their document, Bioassay Guideline 2: Guidelines for Tritium Bioassay, published by the authority of the Minister of National Health and Welfare (83-EHD-87), which includes, in Appendix D, a procedure for the estimation of effective dose from the intake of tritiated water by means of urinalysis measurements. This procedure differs slightly from the ICRP recommendations by including a more detailed estimate of the concentration of tritium in soft tissue derived from urinalysis measurements.

2.2 Policy

The AECB requires that Bioassay Guideline 2: Guidelines for Tritium Bioassay (83-EHD-87) be used for determining the effective dose of radiation from the intake of tritiated water. Licensees are cautioned that this policy document refers only to that part of Bioassay Guideline 2 that is concerned with dose calculation. If licensees wish to use the derived limits in the guidelines, the derived limits must be modified to conform to the quarterly limits in the Atomic Energy Control Regulations.

Sources:

1. ICRP. Limits for Intakes of Radionuclides by Workers. ICRP Publication 30, Part 1, 1979. Annals of ICRP. Vol. 2, No. 3/4.

2. National Health and Welfare. Federal-Provincial Working Group on Bioassay and In Vivo Monitoring Criteria, Bioassay Guideline 2: Guidelines for Tritium Bioassay. Publication 83-EHD-87.

3. Johnson, J.R. The Estimation of the Effective Dose Equivalent from Tritiated Water Exposures Using Tritium Concentrations in Urine. Radiation Protection Dosimetry. Vol. 2, No. 4, Sept. 1982, pp. 245-247.

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