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Taurus-PLEIADES Quality Validation Document

This validation document verifies the quality of the output from the Taurus software by demonstrating the replication of the published International Commission on Radiological Protection (ICRP) Occupational Intakes of Radionuclides (OIR) reference values.

The PLEIADES [1] code was used to generate the reference values for the ICRP OIR publication series – parts 1-5, ICRP publications 130, 134, 137, 141 [2-5] (part 5 to be published) and the data for this series is available as an electronic annex in the ICRP OIR Data Viewer. Taurus uses the PLEIADES code to perform its retrospective and prospective calculations of internal dose. The implementation of the models and calculation method in PLEIADES has been quality assurance tested within ICRP Task Group 95, with intercomparison between the collaborating institutes. These other codes have been developed independently using a variety of computational methods.

"*The ICRP attaches particular importance to quality assurance. The Task Group 95 on Internal Dose Coefficients (IDC) arranged for the quantities given here to be calculated independently at different institutions using different computational methods and computer codes. Any discrepancies were investigated and resolved before inclusion in this electronic annex. The calculation of the dataset and the quality assurance was aided by significant contributions of the following individuals and their institutions: K.F. Eckerman and R. Leggett, Oak Ridge National Laboratory (ORNL), USA, T. Fell, T. Smith, Public Health England (PHE), UK, V. Berkovskyy and G. Ratia, Ukrainian Radiation protection Institute (RPI) and National Research Center for Radiation medicine (NRCRM), Ukraine. The radon dataset was prepared by J. Marsh and D. Gregoratto, PHE.*" – Statement included in the ICRP OIR Data Viewer.

To demonstrate the implementation of PLEIADES in Taurus the following table compares effective dose generated with Taurus to the reference values published in the ICRP OIR series for the EURADOS nuclides of major radiological significance (OIR Guidance Report) [6] using the ICRP default form Type M, an inhalation intake route, and ICRP default model parameters:

Radionuclide		OIR Reference Dose Coefficient e(50) (Sv/Bq)	Taurus Effective Dose Coefficient (Sv/Bq)	Taurus Total Effective Dose (Sv)*
Tritium	H-3	2.4E-11	2.4E-11	2.36E-11
Carbon	C-14	5.8E-10	5.8E-10	5.84E-10
Cobalt	Co-60	6.2E-09	6.2E-09	6.19E-09
Strontium	Sr-90	1.8E-08	1.8E-08	1.81E-08
Yttrium	Y-90	6.8E-10	6.8E-10	6.80E-10
Technetium	Tc-99	1.1E-09	1.1E-09	1.10E-09
Iodine	I-131	2.7E-09	2.7E-09	2.69E-09
Caesium	Cs-137	5.6E-09	5.6E-09	5.64E-09
Lutetium	Lu-177	2.5E-10	2.5E-10	2.52E-10
Radium	Ra-226	1.4E-06	1.4E-06	1.40E-06
Thorium	Th-232	8.2E-06	8.2E-06	8.17E-06
Uranium	U-235	1.3E-06	1.3E-06	1.31E-06
Plutonium	Pu-239	1.4E-05	1.4E-05	1.35E-05
Americium	Am-241	8.0E-06	8.0E-06	7.97E-06

* The intake value is set to 1 Bq for the *quick dose and bioassay* calculation in Taurus.

UK Health Security Agency

The values of the OIR reference dose coefficients match the effective dose coefficients obtained from Taurus. The total effective doses calculated using the *quick dose and bioassay* calculation within Taurus show agreement with the dose coefficients to 2 d.p. and therefore demonstrates the replication of the OIR reference dose coefficients. On this basis, the quality of the output from the Taurus software is verified.

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[1] Fell, T. P., Phipps, A. W., & Smith, T. J. (2007). The internal dosimetry code PLEIADES. Radiation protection dosimetry, 124(4), 327–338. https://doi.org/10.1093/rpd/ncm228

[2] ICRP, 2015. Occupational Intakes of Radionuclides: Part 1. ICRP Publication 130. Ann. ICRP 44(2).

[3] ICRP, 2016. Occupational Intakes of Radionuclides: Part 2. ICRP Publication 134. Ann. ICRP 45(3/4), 1–352.

[4] ICRP, 2017. Occupational Intakes of Radionuclides: Part 3. ICRP Publication 137. Ann. ICRP 46(3/4).

[5] ICRP, 2019. Occupational intakes of radionuclides: Part 4. ICRP Publication 141. Ann. ICRP 48(2/3).

[6] Nosske, D., et al. OIR Guidance Report. EURADOS Report. In preparation.