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The ^{14}C dose assessment model chain – ^{14}C source term definition and uncertainty quantification

Susanne Pudollek, Typhaine Guillemot, Xiaoshuo Li, and Valentyn Bykov

Nagra, 5430 Wettingen, Switzerland

Correspondence: Susanne Pudollek (susanne.pudollek@nagra.ch)

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Abstract. Carbon-14 (^{14}C) is an important, dose-determining contributing radionuclide in a deep geological repository for low and intermediate level radioactive waste (L/ILW). ^{14}C is relevant for safety assessments as it can be present both as dissolved and gaseous species in the disposal facility and the host rock, and ^{14}C-organic compounds migrate in the near field and the geosphere due to weak interaction with mineral surfaces in alkaline to near-neutral conditions. Thus, the chemical form of the ^{14}C-bearing carbon species dictates the routes of ^{14}C migration in the engineered barrier system of a deep geological repository and the surrounding host rock and therefore determines the long-term contribution of ^{14}C to dose release from a repository for radioactive waste. Furthermore, ^{14}C released from a deep repository would be subject to a certain accumulation in the biosphere, given the role of carbon as main building block of any life form on earth.

The contribution will illustrate Nagra's recent progress within the ^{14}C dose assessment model chain for a L/ILW deep geological repository to address the quantification of uncertainties.

The systematic approach began by incorporating a realistic best-estimate plus uncertainty description of ^{14}C activities within the Swiss model inventory of radioactive materials assembled specifically for the purpose of the general licence application. In this context state-of-the-art activation calculations for expected reactor and decommissioning wastes as well as extensive inquiries into origin and use of ^{14}C within medicine, research, and industry played a key role. Uncertainties were screened for relevance and main contributing factors taken into account, differentiating between the characterisation methods of the relevant waste streams.

Based on detailed knowledge of the expected activity and material inventory, release rates for the release pathways through congruent and instantaneous release processes as well as resulting chemical species could be defined with confidence.

Key findings and characteristics of the ^{14}C source term will be highlighted and discussed.

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