



Biosphere modelling in the calculation basis for dose assessment for a final disposal of high-level radioactive waste

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Abstract. The government of Germany decided to isolate high-level radioactive waste (HLW) in deep geological formations. Such a site should guarantee the highest possible level of safety over a period of 1×10^6 years. The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) asked the Federal Office for the Safety of Nuclear Waste Management (BASE) and the Federal Office for Radiation Protection (BfS) to develop a directive for dose assessment for a final disposal of HLW, which has to be used for the site selection process by the Federal Company for Radioactive Waste Disposal (BGE mbH), the operator of the future HLW repository.

This regulation contains detailed provisions for the gas-bound and water-bound radionuclide transport in the geosphere and biosphere and for the dose estimation of the public. It is built upon established concepts in radioecology and dosimetry. The comprehensive set of instructions is a toolbox for the dose estimation of a fictive representative person, one of the indicators of the safety of the repository. Modelling of the biosphere over 1×10^6 years is impossible because natural processes and human activities affect the evolution of the biosphere in an unpredictable way. In addition, human habits like the way of life and agricultural practices cannot be predicted even for only hundreds of years. Therefore, it was laid down in another German regulation that the current human habits have to be assumed over the period under consideration. Existing models and parameters of current German regulations for public dose calculations have been adjusted to the specific conditions of a final repository and complemented where necessary. The challenge of how to take into account the future climate and its implications on the biosphere was solved by using reference biospheres covering all possible evolutions of the biosphere including climate transitions. The application of reference biospheres to cover climate changes is a common approach in comparable safety analyses. Germany favours the enveloping approach described above that implicitly comprises all possible climatic conditions and the corresponding evolutions of the biosphere. The decisions on how to deal with the unknown future were the results of discussions between BMUV, BASE, and BfS.

To ensure transparency and participation in the site selection of the HLW repository, the draft regulation was presented to the public, stakeholders, and the scientific community, providing the opportunity to comment on every part of the content. This consultation process and an expert workshop were the basis of the revision of the draft regulation. The final regulation was published at the end of 2022. The participation process helped to improve the document and to achieve a broader public acceptance. BASE and BfS are currently working on a comprehensive explanatory text to address all of the several hundreds of comments in detail.