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Climate of the Past Discussions

Interactive comment on "How to treat climate evolution in the assessment of the long-term safety of disposal facilities for radioactive waste: examples from Belgium" *by* M. Van Geet et al.

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Review comments on the manuscript How to treat climate evolution in the assessment of the long-term safety of disposal facilities for radioactive waste: examples from Belgium by M. Van Geet1, M. De Craen2, D. Mallants2, I. Wemaere2, L. Wouters1, and W. Cool1 for publication in Climate of the Past.

The manuscript gives an overview of the approach on how to treat climate evolution in assessments of long-term safety when constructing repositories for spent nuclear fuel in Belgium. In doing so, the authors start by giving a detailed description of repository concept and design etc. After that a description of safety assessment and scenario

design is presented, followed by a section on climate evolution, exemplifying studies on available climate projections. The manuscript ends with a relatively short section on how to treat climate in the safety assessments. The text is well written and easy to read, and the figures are good and illustrative.

The described overall approach on how to treat climate in safety assessment work is good. Today’s research within climate and climate related fields such as glaciology, oceanography etc is very expansive, and relevant new results emerge ever so often. This, in combination with the very long time spans of interest when discussing spent nuclear fuel, and the specific challenges this brings in terms of long-term climate change, calls for a specific approach. Even though the field has advanced very much in recent decades, we still have large uncertainties in our understanding of many important climate issues when it comes to long-term climate change.

It is therefore nice to see that the authors recognise the need for describing and analyzing the possible range of climate developments that may occur under the time spans of interest, instead of a heavy focus on a most likely climate development. This is the same approach taken by e.g. Swedish Nuclear Fuel and Waste Management Company (SKB), both in the previous safety assessment (SKB 2006) and the ongoing safety assessment which will be used as part of a license application for building a geological repository for spent nuclear fuel. This approach of dealing with climate in the safety assessment has also got good comments by the Swedish regulating authorities in the formal review of SKB’s previous safety assessment. The authors could refer to e.g. (SKB 2006) and other similar work on using this approach.

For this journal there is an imbalance in the manuscript, with too much initial focus on repository concept and design etc, in relation to the amount of text on e.g. possible climate evolutions or how climate is treated in safety assessment. I suggest reducing the text considerably in Section 2 and 3. Presumably, references to proper reports could be used instead, in order to put more focus on the subsequent climatological aspects.

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Interactive Comment

The description of how scenarios are used in the safety assessment is important for the understanding of how various climate evolutions are to be analysed in the safety assessment. However, also these sections are in my mind too lengthy, and should be shortened, with the inclusion of references to proper ONDRAF/NIRAS reports.

In the section How to treat climate changes in the safety assessment of radioactive waste disposal facilities? it is described that the reference climate case will be a Global warming case, with additional cases describing glacial scenarios. This is fine, and in line with the general approach discussed above. The possibility of regional cooling in Belgium, due to reduced AMOC should be mentioned, even if the cooling would be manifested only as a reduced warming trend. I am not familiar with the possible Belgian repository sites, if they are coastal-near sites or located at somewhat higher altitudes. If sited are located at low elevations, the possible problems associated with sea-level rise should be mentioned, especially since it is part of the reference case.

In cases of colder climates, regardless if it occurs within the coming 150 ka or after that, it is likely that permafrost and associated freezing processes will play an important role given the geographical setting of Belgium. This is an issue that probably should be addressed thoroughly in the climate/safety assessment work. This is briefly mentioned in the manuscript, but it would be good to extend this further, including possible effects of possible freezing of various parts of the repositories. Permafrost also may have a profound effect on ground water flow and chemistry. Possible effects that this may have on the specific repositories should also be elaborated more upon.

In the conclusions it is said: What are we expecting from the phenomenological community: – confirmation of no glaciation within the coming 100 000 years. I am not sure what this is saying. If I interpret the rest of the text correct, this is not to say that colder climate cases will not be treated for the coming 100 ka.

One detailed comment: In section 6.2 it is stated: For the longer time scales related to category B&C waste (beyond 100 000 years up to 1 000 000 years AP), it becomes

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very uncertain to obtain precise climate evolution predictions. This sentence is a gross understatement. Precise climate evolution predictions are not very uncertain to obtain for these time frames, but virtually impossible to obtain. Sentence need to be re-phrased.

In summary, the scope of the manuscript is good and well suited for publication in Climate of the Past. However, sections 2 and 3 need to be shortened, while section 5 and specifically section 6 could be longer, discussing e.g. permafrost/freezing and sea-level (if applicable).

References

SKB 2006: Climate and climate related issues for the safety assessment SR-Can. Swedish Nuclear Fuel and Waste Management Company Report TR-06-23. 186 p.

Interactive comment on Clim. Past Discuss., 5, 463, 2009.