A Biosphere Assessment for Alternative Scenario Cases

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1. Introduction

During the last few years through a series of safety assessment studies, many assessment programs to evaluate the nuclide release behavior from the near- and far-field of repository system as well as biosphere assessment have been developed by utilizing AMBER[1] and GoldSim[2].[3-5] The objectives of this study are twofold; 1) to demonstrate an in-depth stand-alone biosphere assessment tool implemented as a GoldSim template program, by which the dose exposure to humans being due to the radioactive waste repository system can be evaluated, completely exclusive of geosphere modeling for safety assessment of such repository system, and 2) to show its practicality and sensitivity in accordance with several modeling assumptions and relevant scenarios through some illustrations for dose evaluations. Accordingly the final goal of this study is to construct a dose assessment model developed with the aid of GoldSim, by which the dose to the individuals due to long-term nuclide release from the repository system can be predicted and evaluated for licensing purposes. This could finally be linked as a biospheric part to the total safety assessment program necessary for showing the performance of the repository and the safety of the repository as well. Among a few other possibilities, in Korea, a repository system might be typically expected to be located in or at least pretty near a coastal area and situated in the geological medium dominated by such a crystalline rock as granite, covered by typical layers of a groundwater flowing aquifer, unsaturated vadose, and surface soils in the mountain areas, several kilometers off the coast, which seems a reasonable scenario in view of the Korean socio-geographical situation. In such a case, fresh water bodies such as water running rivers, lakes, shallow or even deep wells and near marine water as well as soil sediments beneath such water bodies could be principal geosphere-biosphere interfaces (GBIs), over which nuclides are released from the geosphere and get ready for spreading out into the biosphere. And also throughout the major part of repository area, there could exist terrestrial vegetation through irrigations from various sources of surface fresh waters as well as fishing activities both on the rivers and in the sea areas. Through the current study, with a GoldSim biosphere assessment program that has been developed and then successfully transplanted into a GoldSim TSPA (Total System Performance Assessment) program for the safety assessment of a high and low- and intermediate-level radioactive waste repositories, two illustrative cases are investigated.

2. Illustration

For illustrative purposes, two cases are investigated regarding the hypothetical biosphere environmental system: Two different drinking water scenarios have been calculated and compared with each other and an alternative case scenario by which a new Farming exposure group (called *alternative* exposure group) who are assumed to be exposed to whole exposure pathway available unlike conventional farming exposure group (see Fig. 1*left*) who are exposed only to the limited exposure pathways where they live is separately evaluated and then compared to the conventional exposure case.

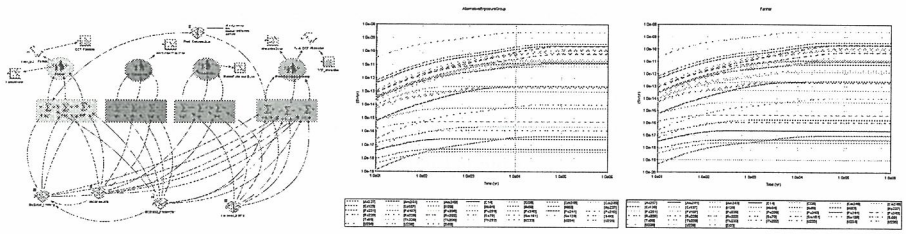

Fig. 1. A GoldSim module with an exposure pathway for the alternative exposure group (*left*) and behaviors of the dose exposure rates to: The alternative exposure group (*center*); conventional farming exposure group (*right*)

Fig. 1*center* shows the case of the dose exposure for the alternative exposure group who are exposed to all the possible exposure pathways including not only the farming scenario but also to the additional river and marine exposure scenarios which revealed similar exposure values for almost all the nuclides when compared with the case for other conventional farming exposure group, as shown in Fig. 1*right*, who are exposed to the exposure pathway limited to the farming scenario. The peak dose rates were compared with each other are also shown in Fig. 2 (*left*). Fig. 2 (*right*) shows the plots for two different drinking water scenarios in which the case of water drinking from the well generally gives higher dose rates for almost all the nuclides than in the case of drinking water from the river.

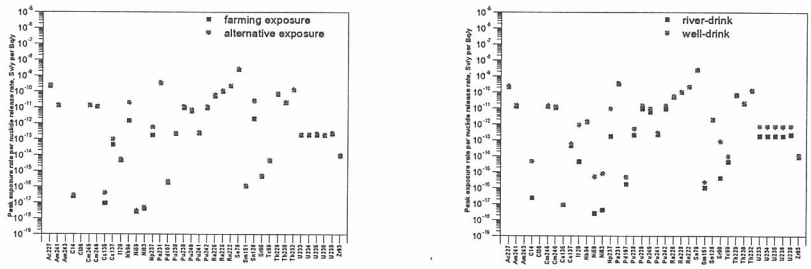

Fig. 2. Peak farming exposure rates with the river water drinking scenario due to nuclide release compared to the alternative exposure group (*left*); and to the well water drinking scenario (*right*)

Therefore, it is concluded, from the result of two illustrated cases that the alternative exposure group seems to be exposed to a higher dose exposure rate, especially when they take drinking water from the well, not the river.

References

1. AMBER 4.4 Reference Guide, Enviros, U.K., 2002.
2. GoldSim, User's Guide, Version 4, GoldSim Technology Group, 2006.
3. Youn-Myoung Lee et al., *Progress in Nuclear Energy*, 51, 746-759, 2009.
4. Youn-Myoung Lee et al., Trans. of the Korean Radioactive Waste Society Spring Meeting, Gyeongju, June 18-19, 2009.
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