Modeling Tools, Techniques, and Standards

Title: **Data Justification in Long-Term Safety Assessment**

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Many countries around the world are currently examining options for the permanent disposal of highly radioactive waste originating from nuclear reactors and other sources. The preference of these countries is deep geologic disposal, where an engineered system is embedded hundreds of metres deep in potential settings that include sedimentary (clay, carbonate, evaporate), volcanic tuff and crystalline rocks. A key component of every international program involves safety assessment (also referred to as performance assessment) to evaluate whether the disposal system could meet certain specific performance standards.

A safety assessment for a high-level waste repository must deal with the inherent complexities and uncertainties associated with (i) the long timeframes of concern (typically 10,000 years and longer), (ii) the limitations in fully characterizing the natural system (the geosphere), (iii) the relatively short period of experience available to make performance predictions of the engineered systems over the long timeframes and (iv) the complex interacting processes that could have wide ranging effects. For these and other reasons, safety assessments rely heavily on mathematical models and computer software to project current understanding into the far future. Most assessments use a probabilistic framework to provide a systematic representation of uncertainties and the uncertainties are largely represented via model parameters with values defined using probability distribution functions (PDFs). Alternatively, or in addition, safety assessments may utilize methodical sensitivity analyses to explore a range of potential combinations of parameter values.

The reliance of safety assessment on computer models dictates strong emphasis on software quality assurance activities, including the justification of parameter data. The purpose of this paper is to highlight the lessons learned from a recent data justification exercise for an independent performance assessment involving hundreds of parameters and many technical experts.

The system model and its parameters cover a diverse collection of scientific and engineering disciplines that have different levels of development and maturity. To extract data justification information for all parameters, a general questionnaire was devised and distributed to the technical experts. The returned questionnaires were evaluated for completeness (some required more information)

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and the results used to build up a database of input data and justification for these data.

The paper will discuss (i) the questionnaire used for gathering information from the technical experts, (ii) the gap between a performance assessor's expectations and the technical expert's responses to questionnaire, (iii) the appropriateness of parameter justification, (iv) the timeframe and scheduling strategy, and (v) the levels of uncertainty used in independent analyses. The paper will highlight the key steps, including actions taken to address gaps in informational input, and make good practices recommendations in gathering parameter justifications.

Our experience shows that the process of gathering parameter justification is a crucial step in developing defensible independent system-level analyses. Although the paper highlights practical experiences related to high-level radioactive waste disposal, the process applies to other disciplines needing system-level assessment.

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