

## The use of natural system evidence in NUMO's pre-selection site-specific Safety Case

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Owing to the heterogeneity and complexity of repository systems and, in particular, the very large temporal and spatial scales over which safety must be assured, the basis of most safety cases for geological disposal of radioactive waste is a quantitative evaluation based on complex mathematical models. The extent to which such models can be validated by conventional approaches (*eg* experiments in a laboratory or an underground rock laboratory) is, however, inherently limited owing to the relatively short temporal and spatial scales involved. As such, any evidence gained from relevant long-lived and large scale natural systems that have similar properties to the components of a geological disposal system should thus be of great use in directly supporting the safety case. This can be in a quantitative or qualitative fashion or, alternatively, simply by providing illustrations of concepts or processes that can demonstrate long-term safety.

Whilst there has been to date no choice of host rock or site in Japan, NUMO has developed a novel pre-selection site-specific safety case (the NUMO 2015 Safety Case). This provides evidence, analyses and arguments that demonstrate the technical feasibility and long-term safety of geological disposal in Japan *per se*. As part of this, following the lines of the arguments laid out above, multiple lines of natural system evidence that focus mainly on the performance and future behaviour of the materials used in a repository have been included in the safety case. For example, demonstrating the suitability of the vitrified high-level radioactive waste form has used evidence on the long-term durability of natural basaltic glasses. In the case of cementitious TRU wastes, natural cements of several million years age from Jordan and the UK have been investigated to define the likely long-term evolution of this material. The host rock stability over a long period of time, up to one million years, has been assessed in a similar fashion with comparison with similar sites worldwide. For example, the long-term persistence of hydrogeochemical and hydrogeological stability has been characterised in deep sedimentary formations in Japan, Switzerland and France.

Overall, the use of natural system evidence to support the NUMO 2015 Safety Case will be presented here.