FOREWORD

This publication was initiated by the NEA Integration Group for the Safety Case (IGSC), a technical advisory body to the NEA Radioactive Waste Management Committee. The IGSC brings together national programmes that are investigating the deep geological disposal of long-lived and high-level radioactive waste, and its focus is on the science and technology underlying long-term repository safety and on methods to improve confidence in repository safety cases.

A repository "safety case" is defined as a synthesis of evidence, analyses and arguments that quantify and substantiate a claim that the repository is safe. It typically provides a comprehensive and specialised assessment of the expected long-term safety and potential impacts of a radioactive waste repository. For deep geological disposal, studies of the geosphere form a principal component of the safety case. Geoscientific information is unique in that it can offer evidence and lines of reasoning that span geological timescales (millennia and even longer). It may involve diverse information from many sub-disciplines, such as geophysics, hydrogeology, geochemistry and paleohydrogeology. Another important characteristic of geoscientific information in the context of radioactive waste disposal is that the level of information and understanding evolves over repository development. Iterative improvements in the breadth and depth of information through different phases of repository investigations and implementation lead to a better understanding of the geosphere and its evolution, contributing to a more comprehensive safety case.

The NEA Approaches and Methods for Integrating Geological Information in the Safety Case (AMIGO) project is concerned with the collection and integration of geoscientific evidence, analyses and arguments that contribute to an understanding of long-term safety. The AMIGO project was structured as a series of three workshops which were held in 2003, 2005 and 2008. Together with the results of a detailed AMIGO questionnaire, the outcomes of the workshops provide guidance on how geological information can be collected, synthesised and applied to reach conclusions and to build confidence in safety cases for deep geological disposal.

The first AMIGO workshop focused on building confidence in analyses and arguments that support the safety case, including the use of multiple lines of evidence. The topics addressed at AMIGO-1 included the role of the geosphere in disposal concepts, the synthesis of geological information in conceptual models and the types of safety case arguments that can be derived from (or based upon) geological information. The second AMIGO workshop expanded upon the AMIGO-1 deliberations to examine how geoscientific arguments and evidence are assembled and linked to create a unified and consistent description of the geosphere (i.e. a geosynthesis) in support of a safety case. It also examined the extrapolation and transfer of geoscientific information in time and space, and some practicalities of collecting, linking and communicating this information. A compilation of responses to an AMIGO questionnaire provided numerous examples of geoscientific support for site-specific repository concepts in various types of host rocks.

This publication summarises the third and final workshop of the AMIGO series, held at the École des Mines, Nancy, France, on 15-17 April 2008, and hosted by the French National Agency for Radioactive Waste Management (Andra). The AMIGO-3 workshop on "Approaches and Challenges

for the Use of Geological Information in the Safety Case" provided a logical continuation of the themes covered by the first two AMIGO workshops. It focused on complementary topics with regard to both the earlier workshops as well as on the outcomes of the AMIGO questionnaire. The workshop also considered the links and feedback among the safety case; design, engineering and construction issues; and geoscientific investigations.

In all, more than 50 individuals representing 16 national programmes and international organisations participated in AMIGO-3. Participating organisations at the workshop ranged from those that are still at an early, generic stage with no selected host rock to those that are more advanced, including those at or near the stage of repository operation.

The outcomes of the workshop underscored that geoscientific information plays a fundamental role in safety assessments. It is also increasingly used in the wider context of the safety case to provide evidence and arguments for the intrinsically favourable properties of a site, including its long-term stability. No single geoscientific argument "proves" safety, but rather each supports some key element of the safety case and provides enhanced confidence in the safety case.

The importance and application of geoscientific information in safety cases is supported, with growing frequency, by integration of wide-ranging information in a "geosynthesis". A geosynthesis (or site descriptive model) integrates the various and complementary types of data from field investigations and associated laboratory studies in a single, coherent, logical and defensible description of a site. It not only provides specialised information and data such as groundwater flow rates, geosphere sorption parameters and data on rock stress needed to support safety assessment and engineering studies, but also provides complementary evidence (e.g. for intrinsically favourable properties of a site, including its long-term stability) to support the safety case.

Earlier AMIGO workshops had already emphasized the importance of effective communication between geoscientists and safety assessors in order to promote completeness in the information included in a geosynthesis, to ensure consistency between information of different types and to identify all relevant uncertainties. Conversely, information gaps or needs for safety assessment can have important implications for the types of data required from geoscientific investigations. A range of project tools and methods is available to support the integration of geoscientific information in geosyntheses and in safety cases. The AMIGO-3 workshop provided practical and encouraging examples of progress from several national programmes in achieving integration in practice.

This need for effective integration of information is only heightened when considering the links with repository design and, hence, with engineers and other technicians. Clearly, geoscientific information is a key input to repository design: at a certain stage in a repository development programme, the safety concept and repository design must be adapted to site-specific conditions. Examples were given of how the safety concept and repository design are adapted to site-specific conditions, guided, for example, by safety-related and other criteria on the properties of a rock block that make it suitable for tunnel construction or waste emplacement. There is thus a strong link between safety concepts and associated repository design on the one hand, and site characterisation on the other.

Plenary presentations and working group discussions at the workshop allowed in-depth exploration of these issues, and identified a number of emerging trends in the use and integration of geoscientific information in safety cases which are described herein. Papers presented at the workshop can be found on the enclosed CD-ROM.