

FORGE

Fate Of Repository Gases

European Commission FP7

Plan for Using Dissemination and Knowledge Actions (PUDKA)

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Euratom 7th Framework Programme Project: FORGE



Fate of repository gases (FORGE)

The multiple barrier concept is the cornerstone of all proposed schemes for underground disposal of radioactive wastes. The concept invokes a series of barriers, both engineered and natural, between the waste and the surface. Achieving this concept is the primary objective of all disposal programmes, from site appraisal and characterisation to repository design and construction. However, the performance of the repository as a whole (waste, buffer, engineering disturbed zone, host rock), and in particular its gas transport properties, are still poorly understood. Issues still to be adequately examined that relate to understanding basic processes include: dilational versus visco-capillary flow mechanisms; long-term integrity of seals, in particular gas flow along contacts; role of the EDZ as a conduit for preferential flow; laboratory to field up-scaling. Understanding gas generation and migration is thus vital in the quantitative assessment of repositories and is the focus of the research in this integrated, multi-disciplinary project. The FORGE project is a pan-European project with links to international radioactive waste management organisations, regulators and academia, specifically designed to tackle the key research issues associated with the generation and movement of repository gasses. Of particular importance are the long-term performance of bentonite buffers, plastic clays, indurated mudrocks and crystalline formations. Further experimental data are required to reduce uncertainty relating to the quantitative treatment of gas in performance assessment. FORGE will address these issues through a series of laboratory and field-scale experiments, including the development of new methods for up-scaling allowing the optimisation of concepts through detailed scenario analysis. The FORGE partners are committed to training and CPD through a broad portfolio of training opportunities and initiatives which form a significant part of the project.

Further details on the FORGE project and its outcomes can be accessed at www.FORGEproject.org.

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Summary

This report describes how the data and knowledge arising from FORGE will be disseminated as widely as possible both within the European and International radioactive waste disposal communities and to the wider stakeholder audience.

1. Introduction

FORGE is a large project with 24 partners from 12 EU countries, plus Associate Members in both North America and Japan. Dissemination of information and knowledge both within the project and to a wider scientific audience is an important element of the project. It is equally important that this information is also available beyond the end of the life of the project. The aim of this report is to document how this will be achieved during the project and in the medium term after the project has ended. It is important to note that this plan does not deal with existing knowledge on the topic of repository gas migration.

A key element of this plan is to make all knowledge arising from FORGE as widely available as possible as soon as it is practical to do so during the project. To this end, as much information as possible will be disseminated digitally.

FORGE will utilise a number of tools to reach its target audiences. These are described in more detail in the following sections.

2. Website

FORGE has established a website at www.FORGEproject.org which will be used to make available all reports arising from FORGE and to provide access to data. This site will be the primary means of disseminating project reports to the wider audience. Once finalised these reports will be freely downloadable. The website will also have a section for wider outreach. The site will be available for at least five years after completion of the project.

2.1 REPORTS

A major output of FORGE will be the preparation of synthesis reports based on each work package highlighting key advancements in process understanding for the treatment of gas in repository performance assessment. In addition, a key output of the project will be the publication of an overview report (ca 50pp) summarising the results and achievements of the totality of the project and their implications for performance assessment. The end-users for this document are expected to be scientists with an interest in gas migration in sub-surface environments including waste disposal, carbon dioxide storage, gas storage and hydrocarbon exploitation, as well as radioactive waste disposal. Once completed, all such reports will be made available from the web site in pdf format.

At the conclusion of the project all work packages will contribute to a final project overview report outlining the principal outcomes (advances in process understanding, conceptual and numerical model developments, new PA methodologies, recommendations for the management of gas in current repository designs concepts) achieved by the FORGE project. This

state-of-the-art information will be published as an EU report, with the key findings of the work presented at a suitable European scientific venue.

All leaders and appropriate team members will be involved in meetings arranged within the other work packages to ensure full integration of their activities. In addition, there is a cross-cutting co-ordination task (modelling co-ordinator) which will be undertaken in parallel to the other work packages to ensure that there is both synergy between the various modelling activities and that modelling activities accurately reflects experimental parameters.

The Co-ordination Team will also publish a series of peer-reviewed papers as themed volumes based on the output of each workshop (Section 3.2.1). As a minimum, these will be published as workshop proceedings in BGS Technical Report (or similar) format. However, to achieve greater impact, the Co-ordination Team will endeavour to have these published by a major publishing company in the form of one or more books presenting the state-of-the-art in gas migration, related numerical modelling, PA and repository design optimisation. These will be a valuable resource, which will be made widely available to stakeholders, other industries, academia and the general public. It should be noted that the date of such publications is likely to be beyond the end of the project because of the lengthy peer-review, editorial and publications processes.

In addition to project reports a key dissemination medium will be peer-reviewed scientific papers. Each project participant will produce at least one such publication ensuring the high scientific impact of FORGE. Individual participants will also be expected to publish the outcomes of their FORGE-related activities on their own websites and include them in their bibliographies.

3. FORGE Themed Workshops

To ensure the dissemination of FORGE outcomes to a wide technical audience partners will present their results at themed workshops planned for the latter part of the project (2011/2013). Particular emphasis will be placed on soliciting contributions and participation from other disciplines, such as gas storage and carbon dioxide storage. The location of workshops will be selected to encourage the cost effective participation of newer EC member states, e.g. the Czech Republic, Romania and Hungary.

Potential topics for one-day themed workshops may include:

- Mechanisms and processes governing gas migration in the near field (Engineered Barrier Systems and Engineered Disturbed Zone) and its impact on repository performance;
- Mechanisms and processes governing gas migration in undisturbed rock formations (with application to both repository systems and Carbon Capture and Storage (CCS));
- The treatment of gas in repository design and performance assessment.

These workshops will be open to participants outside FORGE.

3.1 FINAL WORKSHOP

The steering committee, with EC support, will organise an international symposium towards the end of the project, expected data will be around February-March 2013. This event will be aimed at the dissemination of FORGE outcomes to both the radioactive waste stakeholder community and also to scientists and policy makers from other relevant industrial sectors, including CCS, gas storage, hydrocarbon management and exploitation and toxic waste disposal.

4. Conferences

Beneficiaries of FORGE will be actively encouraged to participate in the next Euratom meeting and conferences such as that being planned by Andra in Nantes (spring 2010) and the following meeting in Autumn 2012 by which time the majority of work in the project will have been completed.

5. Training and related activities

Training of scientists and engineers is a key component of the EURATOM FP7 program and an important aspect of the project will be ensuring that younger scientists are afforded opportunities for their on-going professional development through participation on project workshops, co-authorship of peer reviewed papers, etc. as well as by their involvement in a major pan-European collaborative project. Partners in FORGE consider training will be one of the principal outcomes of the project; one of its lasting legacies will be new scientists equipped for the challenges of leading future phases of radioactive waste disposal programmes. Over 8% of the FORGE budget, and approximately 10% of staff effort, is directly devoted to training related activities. A minimum of ten dedicated postgraduate students will be working wholly or largely on FORGE activities and many more, in taught undergraduate and postgraduate courses, will have opportunities to experience leading-edge research through FORGE. Participation of postdoctoral scientists is also an important aspect of the project.

The workshops proposed in section 3.2.1 (above) are an integral component of this training effort. They will be vital in ensuring effective collaboration between the different participants in FORGE and the transfer of knowledge, both within the project and to the wider scientific community. It will also provide the opportunity for scientists near the start of their career to present their work to their peers thus promoting both their science and their own capabilities. This will enhance the network of leading scientists established under the Implementing Geological Disposal Technology Platform being established (see ftp://ftp.cordis.europa.eu/pub/fp7/fission/docs/euradwaste08/papers/paper27-card-proposed-european-technology-platform-a-hooper_en.pdf for details).

1.2 MOBILITY FUND

All partners in FORGE are acutely aware that there is a significant requirement to better integrate work across the radioactive waste disposal field with the aim of ensuring that well-trained and well-informed professionals join this industry in the future. It has therefore been decided to include a mobility fund within the project. This is intended to support the travel and subsistence needs for junior scientists so that they can exchange between contributing institutions to allow them to gain expertise and experience outside their own institution.

Training is integral to FORGE and will be addressed in all parts of the project. This function is wholly integrated into the structure of the project and involves training at every level from results contributing to taught undergraduate, masters and doctoral student programs, through support for doctoral students and post-doctoral researchers working partly or wholly on projects directly related to FORGE research to in-house training at WMO's. Departments from five universities are direct participants in FORGE, other universities will be involved in postgraduate supervision in collaboration with research institutes and industrial partners. Continuing Professional Development of all scientists and engineers involved in FORGE will be

facilitated by their involvement in this project through their attendance at the workshops and opportunities to share research techniques and ideas.

The FORGE project will actively seek to disseminate knowledge through dedicated training courses for students and geoscientists and other stakeholders. This will help promote the cross-fertilisation of ideas between neighbouring scientific disciplines and to minimise duplication of effort. This will be achieved through a range of media including the FORGE website and scientific publications. Links to European Nuclear Engineering Network (ENEN), ITC - School of Underground Waste Storage and Disposal (see <http://www.itc-school.org/>) and academia will also be exploited. Several of the partners in FORGE, including the Co-ordinators, are members of the ITC School and intend to support their training activities through participation in ITC-led training including, for example, the development of specific courses on gas migration issues.

Dissemination of knowledge from FORGE to other European/international initiatives, such as Geological Disposal Technology Platform (CARD), OECD-NEA, IAEA will happen as a natural consequence of the pre-existing links between the FORGE beneficiaries and these organisations. A number of the key participants of FORGE are already members or representatives on such bodies and will seek active participation of these organisations in promoting the FORGE workshops to wider stakeholders.

5.1 MASTERS AND DOCTORAL STUDENTS AND POST-DOCTORAL RESEARCH

A number of FORGE partners are intending to support full time doctoral students or contributions to taught masters and doctoral programs within the work packages to undertake aspects of their research including:

- CNRS will integrate modelling from the FORGE program into taught masters and doctoral courses on multi-phase flow in heterogeneous media at the University of Pau (WP 1);
- NRI will be undertaking parts of their research using a doctoral student (WP 3);
- IRSN will be using a doctoral student to undertake 3D modelling calculations (WP 3);
- BGS will be utilising a full time doctoral student to undertake key experiments (WP 3/4);
- EDF will be utilising a doctoral student to undertake modelling tasks which will form an important part of his work (WP 4);
- ULg will be using a significant proportion of their funding for two doctoral students for part of their research (WP 4 & 5);
- ULg will also be supporting training opportunities to taught masters and doctoral programs through the European ALERT network, will be partner of at least one doctoral school on Multiphysic Coupling in Geomechanics and are also co-organiser of this course for the Belgian doctoral school GraSMech (WP 4 & 5);
- CTU-CEG will provide experience to doctoral students working on the project and contribute to post-graduate course components. They will also train a minimum of one doctoral student to work on the project (WP 4);
- CIMNE-UPC have demonstrated a clear commitment to training as their team is comprised of faculty staff and doctoral students. A significant part of the work will be performed by a doctoral student. Master's students will also be involved in the project which will then form parts of their thesis (WP 4 & 5);
- NDA will fund a full-time doctoral student to working on experimental and modelling components (WP 5).

- LEI will perform part of their research using a doctoral student (WP1).

5.2 UNDERGRADUATE

Results from FORGE will be used to contribute to undergraduate courses at a number of participating institutions, for example the University of Liege will be contributing doctoral to Undergraduate courses through the European ALERT network.