



EUROPEAN
COMMISSION

Community research

Contract Number: FP6-036458

THERESA

Coupled

**Thermal-Hydrological-Mechanical-Chemical
Processes for Application in Repository Safety**



Executive Summary of the Periodic Activity Report

Instrument: STREP

Thematic Priority: Nuclear energy – management of radioactive waste

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Period covered: From 01/01/2007 to 31/12/2007

Date of Preparation: 14/04/2008

Start date of project: 01/01/07

Duration: 36 months

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Project coordinator organization name: Kungliga Tekniska Högskolan

Project co-funded by the European Commission under the Euratom Research and Training Programme on Nuclear Energy within the Sixth Framework Programme (2002-2006)

Dissemination Level

PU	Public	
RE	Restricted to a group specified by the partners of the [THERESA] project	
CO	Confidential, only for partners of the [THERESA] project	

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Date of issue of this report: 14/04/2008



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Executive Summary

This proposal aims to develop a scientific methodology for evaluating the capabilities of mathematical models and computer codes used in Performance Assessment (PA - using process level models) or Total System Performance Assessment (TSPA - mostly using simplified PA models), and applied to the design, construction, operation, performance and safety assessment, and post-closure monitoring of geological nuclear waste repositories, based on the scientific principles governing coupled thermo-hydro-mechanical and chemical (THMC) processes in geological systems and geo-materials. The project work will be concentrated on the most essential issues for PA, with focus on rock salt, buffer materials and the buffer-rock interface, as guided by the tool of Issue Evaluation Tables (IET). The evaluation will be carried out by scientific/technical auditing (TA) procedures. The evaluation will examine the participating teams' codes and approaches in terms of system characterisation (conceptualisation, simplification, mathematical representation and parameterisation), flexibility in handling realistic *in-situ* geological conditions, capacities in uncertainty source identification and treatment, and computational aspects. The evaluation will be organised around numerical simulations of small-to-moderate scale laboratory tests, specifically defined generic Bench-Mark Tests (BMT), and large-scale in-situ experiments (Test Cases - TC) involving coupled THM, HMC or THMC processes in rock salt and buffer material, so that simulations and evaluations can be conducted within a realistic physical context. This proposed project represents a coherent and logical effort based on sound scientific principles, and with potentially far-reaching consequences in the field of nuclear waste disposal.

Five work packages (WP1-WP5) are planned to achieve these objectives. WP1 is the overall planning package, designed to oversee the implementation of the other four work packages throughout the duration of the project. WP2 will, in "Issue Evaluation Tables" (IETs), identify the specific issues in PA that are related to THMC modelling, and will, through continuous updating, guide the project in addressing the relevant issues. WP3 and WP4 are the packages addressing numerical modelling of coupled THMC processes in salt and buffer, respectively. WP5 is defined to implement the TA of the models and codes applied in WP3 and WP4, according to specifically developed IETs and TA procedures. The exchange of ideas and work implementation check-ups will be achieved mainly through regular workshops and specific task force group meetings.

For the first reporting period of the project (Jan. 1 - Dec. 31, 2007), the work focused mainly on the project planning, preparation of the computing tools, collection of laboratory experiment data, preliminary benchmark simulations and procedure of technical auditing. The work performed and achievements during this period can be summarized, as below, in the order of work packages.

WP1: The overall project plan that was completed in this period and delivered (Deliverable 1), but will be updated during the project.

WP2: Two IETs were constructed as first drafts for WP3 and WP4, respectively, and are undergoing internal discussions and improvements. They were submitted for external review by the members of a Scientific Advisory Committee (SAC). The second drafts will be completed in 2008. No deliverable is required in this reporting period.

WP3: Besides the construction of the IET for WP3, the main work performed are the code preparation and laboratory experimental data collection and analysis for validation and improvements of constitutive models of rock salt. The work defined for the first reporting period is largely complete, and the required Deliverable 12 was submitted on time, and the required data and information on computer codes and constitutive models were provided to WP5. The results were reported in a project plenary meeting (Nov. 20-21, 2007) and a task force meeting (May 31, 2007).

WP4: Besides the construction of the IET for WP4, the work performed included the code preparation and laboratory experimental data collection and analysis for validation and improvements of constitutive models of buffer, and development of buffer-interface models. Three Bench-Mark-Test (BMT) problems were defined and simulated by contractors working with WP4 in order to verify their codes and models. No deliverables were required for this reporting period. The results were reported in a project plenary meeting (Nov. 20-21, 2007) and a task force meeting (May 16, 2007).

WP5: For this reporting period, the work performed consisted mainly of the auditing of the basic scientific principles governing the THMC processes considered in WP3 and WP4, the functions and capabilities of the applied computer codes and their present status and planned improvements. The technical content, evaluation criteria and auditing procedure were defined and distributed and followed by all contractors working with WP3 and WP4 problems. The auditing proceeded successfully, and the required Deliverable 14 was submitted on time.

Besides the above work performed, planning work for use and disseminating of knowledge was conducted mainly through a planned international conference on the THM processes and EDZ phenomena near the end of the project time, in co-operation with TIMODAZ project in the EC 6FP. A project presentation was also submitted, and appeared in EC issued booklets as information for the general public.

Three PhD students are involved in the project (at KTH, TUC and CU), and they have contributed significantly to the progress of the progress of the project.