August 17, 2000

MEMORANDUM TO: C. William Reamer, Chief
High-Level Waste Branch
Division of Waste Management

THRU: N. King Stablein, Chief ***/RA/***
Projects/Engineering Section
High-Level Waste Branch
Division of Waste Management

FROM: Mysore Nataraja ***/RA/***
Projects/Engineering Section
High-Level Waste Branch
Division of Waste Management

SUBJECT: TRIP REPORT, SECOND STEERING COMMITTEE MEETING AND WORKSHOP, DECOVALEX PROJECT PHASE III

I attended the second Steering Committee meeting and workshop on the coupled thermal-hydrological-mechanical (THM) processes project (Phase III) for waste repositories**,** held in Meiringen, Switzerland between June 6 and 8, 2000. I also visited the underground test facility at Grimsel Pass on June 9, 2000. This trip report summarizes the highlights of the meeting and the site visit.

BACKGROUND

DECOVALEX is the acronym for **DE**VELOPMENT OF **CO**UPLED MODELS AND THEIR **VAL**IDATION AGAINST **EX**PERIMENTS. DECOVALEX is an international cooperative project that supports the development of mathematical models of coupled THM processes in the geosphere and their applications and validation against experiments in the field of nuclear waste isolation. The Steering Committee for the project is managed by the Swedish Nuclear Power Inspectorate (SKI) through the Swedish Royal Institute of Technology and is chaired by Dr. Chin Fu Tsang of the Lawrence Berkeley National Laboratory. More than a dozen countries participate both by funding and by actual performance of tasks. Phase I and Phase II of the project have been completed, and the U.S. Nuclear Regulatory Commission (NRC) participated in the first phase between 1992 to 1995 and is currently funding the third phase (Phase II, between 1995-1999 was not funded by NRC). The workshop I attended was to review the progress to date and plans for the future.

DECOVALEX PHASE I

During phase-I of the project, three benchmark tests were studied: (1) BMT1- Far-field model to simulate THM processes in a large volume of rock located at 500 meters depth; (2) BMT2 - Near-field model of a multiple fractured rock mass; and, (3) BMT3 - Near field model of a realistic fracture network around a rock opening 50mX50m, 500m deep. Six test case

problems were also studied: (1) TC1 - Study of a coupled shear flow experiment of a single rock joint (Norway); (2) TC2 - In situ Thermal-Mechanical (TM) experiment at Fanay Augeres (France); (3) TC3 - Laboratory experiment of engineered barriers (Japan); (4) TC4 - Hydrological-Mechanical (HM) behavior of rock joints (Finland); (5) TC5 - HM behavior of jointed rocks (USA); and, (6) In situ borehole injection, HM study (Sweden). After the study of benchmark tests and the test cases, it was concluded that: (1) the thermal processes in fractured and continuous media were well understood and the existing models could be successfully used to predict temperature distributions; (2) mechanical processes such as distribution of stresses around excavations were reasonably predicted using the current models, while the reliability of displacement predictions would depend on the extent of fractures and their distribution; and finally, (3) hydrologic processes in fractured rocks were not well understood.

DECOVALEX PHASE II

During phase II of the project, two field studies were modeled: (1) Kamaishi mine engineered barrier study in Japan; and (2) Sellafield intermediate waste repository in the United Kingdom. In addition, two studies were undertaken: one on the review of constitutive models for jointed rocks, and the other on the review of THM processes that might have an impact on performance assessments. Because the Sellafield shaft construction was canceled, many of the “blind” predictions made by participating organizations using different conceptual models and numerical codes could not be verified. The results of the Kamaishi experiment showed different degrees of agreement with actual measured/observed behavior. The lessons learned during phase II are summarized in the following main conclusions: (1) a THM predictive capability is required to support repository design, because there is no past experience in this area; (2) many aspects of THM processes and modeling are now well understood, and there is a variety of numerical codes available to provide solutions for different host rock and repository conditions; (3) modeling all the THM mechanisms in space and time is extremely complex and, therefore, simplifications will have to be made; (4) it is not always possible to obtain all the necessary detailed supporting information for use in the modeling studies; (5) the THM modeling requirements and the supporting data needs should be defined in the context of performance assessment; and, finally, (6) a transparent audit trail should be developed to help documentation of all testing, modeling and analyses.

DECOVALEX PHASE III

The objectives of DECOVALEX phase III are the same as those for the previous two phases, namely: (1) to increase the basic understanding of THM coupled processes in fractured rocks and buffer materials; (2) to investigate the predictive capabilities of different codes by comparison of results with field test data; (3) to exchange experimental data and improve understanding of constitutive laws for rock masses and buffer materials; and (4) to review the state of the art in coupled THM issues in performance assessment. The Steering Committee has agreed to conduct four tasks under Phase III, and they are: (1) modeling of a field test conducted in Switzerland; (2) modeling of Yucca Mountain (YM) Drift Scale Heater Test; (3) modeling of selected benchmark test problems for treatment of coupled THM processes in performance assessment; and, (4) establishing a forum to discuss and document methodologies for the treatment of THM processes in performance assessment. NRC has committed to participate in Task-2, modeling of the drift scale heater test at the Yucca Mountain site and Task-4.

PROCEEDINGS OF THE WORKSHOP

The participating organizations presented progress in their work to date in their respective tasks. Only some details of those tasks in which the NRC is participating are summarized here. (1) Preliminary results on Task-2, (Yucca Mountain Project Drift-Scale Heater Test), T-H analyses conducted at the Center for Nuclear Waste Regulatory Analyses (CNWRA) were presented by Ronald Green. The approach consists of performing T-H analyses using a code developed at the CNWRA (MULTIFLO), and the output will be used as input for T-M analyses to be performed using UDEC. Although some comparisons of actual measurements and computed results were presented, more work needs to be done before making definitive conclusions on the acceptability of the model and the code.

(2) J. Anderson, a consultant who is working on Task-4, presented his compilation of answers to the questionnaire circulated among the participants. The report he is preparing for the project will highlight the approaches being used by various high-level waste management projects in dealing with the issue of coupled thermal effects in conducting performance assessment. NRC-CNWRA team has provided its input to this report and will review the report before it gets finalized.

STEERING COMMITTEE MEETING

The Steering Committee was held at the end of the workshop to discuss the status of budget, schedule and future activities. SKI pointed out that the foreign exchange money that was sent by NRC had not reached DECOVALEX project as of the date of the meeting. The money was sent to SKI on March 3, 2000 as per the responsible NRC accounting personnel. The check is being traced to find out its status.

Two new organizations (CEA of France and BGR of Germany) have expressed interest in joining the project. The Steering Committee has agreed in principle, to admit them if they are willing to join before the end of CY 2000. A decision was also made to restrict the entry for potential future candidate countries wishing to join.

An attempt is being made to get additional funding from the European Union for supporting some of the activities of the project by submitting a proposal. Many members of the Steering Committee (including NRC) requested additional information related to the terms and conditions of such an arrangement and details of the proposed project commitments and their potential impacts. Participating organizations will receive the requested information detailing how the EU work, and the current project will be managed without mutual interference or conflict before a formal commitment is made.

After a lengthy discussion, it was decided to hold the next Steering Committee meeting and the third workshop in Japan. (JNC will host the meeting and arrange for all the task group meetings.) The date for the Steering Committee meeting and workshop was set to be in the last week of January 2001.

SITE VISIT TO GRIMSEL TEST FACILITY

Two major experiments are being conducted at the Grimsel Test Site (GTS). The first one which is being used as an example for code validation under Task-1 of DECOVALEX project, is

a study of the constructibility of an engineered barrier system. A drift-scale heater test is being conducted in a 17-m long tunnel which is sealed off with a concrete plug. The effectiveness of the bentonite barrier will be tested after the completion of the heater experiment when the plug will be dismantled. In the second, a T-M-H experiment, is under construction in a 5-m diameter silo which is 5-m deep. Currently, water samples are being collected before emplacing bentonite and the heater. Several of the participating organizations are involved in modeling the results of these experiments.

NEXT STEP

The Steering Committee will meet in January 2001 to discuss progress and document the status of Phase-III activities. The next step for NRC-CNWRA team is to complete modeling of T-H aspects of the YM drift-scale heater test and prepare input for the T-M modeling. Repository Design Thermal Mechanical Key Technical Issue will appropriate necessary funds for FY 2001 at the CNWRA for conducting the necessary modeling studies.

Additional information related to this trip may be found in the CNWRA's trip report by Ronald Green dated June 27, 2000. If there are any questions about this trip or the contents summarized in this trip report, I can be contacted at (301) 415-6695 or though e-mail (msn1). Ronald Green may be contacted at the CNWRA for additional details.

SITE VISIT TO GRIMSEL TEST FACILITY

Two major experiments are being conducted at the Grimsel Test Site (GTS). The first one which is being used as an example for code validation under Task-1 of DECOVALEX project, is a study of the constructibility of an engineered barrier system. A drift-scale heater test is being conducted in a 17-m long tunnel which is sealed off with a concrete plug. The effectiveness of the bentonite barrier will be tested after the completion of the heater experiment when the plug will be dismantled. In the second, a T-M-H experiment, is under construction in a 5-m diameter silo which is 5-m deep. Currently, water samples are being collected before emplacing bentonite and the heater. Several of the participating organizations are involved in modeling the results of these experiments.

NEXT STEP

The Steering Committee will meet in January 2001 to discuss progress and document the status of Phase-III activities. The next step for NRC-CNWRA team is to complete modeling of T-H aspects of the YM drift-scale heater test and prepare input for the T-M modeling. Repository Design Thermal Mechanical Key Technical Issue will appropriate necessary funds for FY 2001 at the CNWRA for conducting the necessary modeling studies.

Additional information related to this trip may be found in the CNWRA's trip report by Ronald Green dated June 27, 2000. If there are any questions about this trip or the contents summarized in this trip report, I can be contacted at (301) 415-6695 or though e-mail (msn1). Ronald Green may be contacted at the CNWRA for additional details.

DISTRIBUTION: NMSS r/f HLWB r/f JGreeves DBrooks RGreen, CNWRA OSR

ADAMS Accession #: ML003727460

DOCUMENT NAME: Meiringen_Tripreport.wpd

OFC	HLWB		HLWB							
NAME	MNataraja/jcg		NKStablein							
DATE	8/14/00		8/17/00							

OFFICIAL RECORD COPY

ACNW: YES X NO ___ Delete file after distribution: Yes X No ___

1) This document should be made available to the PUBLIC _____ / /
(Initials) (Date)

2) This document is related to the HLW program. If it is related to HLW, it should/should not be placed in the LSS. _____ / /
(Initials) (Date)