SAND2008-2202C

SAND 2008-2202C

Taiwan Industrial Cooperation Program (ICP)

SNF Phase II Closeout Meeting

at AEC/FCMA, Taipei, Taiwan

Technology Transfer for Interim Dry Storage and Final Disposal of Spent Nuclear Fuels

April 17, 2008

Hong-Nian Jow

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

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Main Objectives of SNF Phase II

1. Transfer technologies to FCMA (Fuel Cycle Materials Administration) of Atomic Energy Council (AEC) in selected safety analysis methodologies for spent nuclear fuel (SNF) dry storage casks.

2. Transfer technologies to Institute of Nuclear Energy Research (INER) and Energy and Environment Laboratory (EEL) in final geologic disposal of spent nuclear fuels.

Phase II builds on progress made under Phase I (June 2003-August 2004)

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ICP SNF Phase II Tasks

Six Major Tasks for ICP SNF Phase 2:

I. SNF Dry Storage Safety Analysis

1. Structural seismic analysis methodology
2. Review of thermal analysis in Safety Analysis Report (SAR)

II. Geologic Repository Technologies

1. Site Characterization
2. Conceptual model development
3. Flow and Transport model development and applications
4. Review of INER and EEL technical reports

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Sandia Team Members

Project Manager:

Hong-Nian Jow

Technical Staff:

I. SNF Dry Storage Safety Analysis

Mike Hessheimer, Jeff Smith, Jason Petti and Carlos Lopez

II. SNF Geologic Repository

Rick Beauheim, Randy Roberts, Bill Arnold, Patrick Mattie, Sean McKenna, and Joe Schelling

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Sandia Contact Persons

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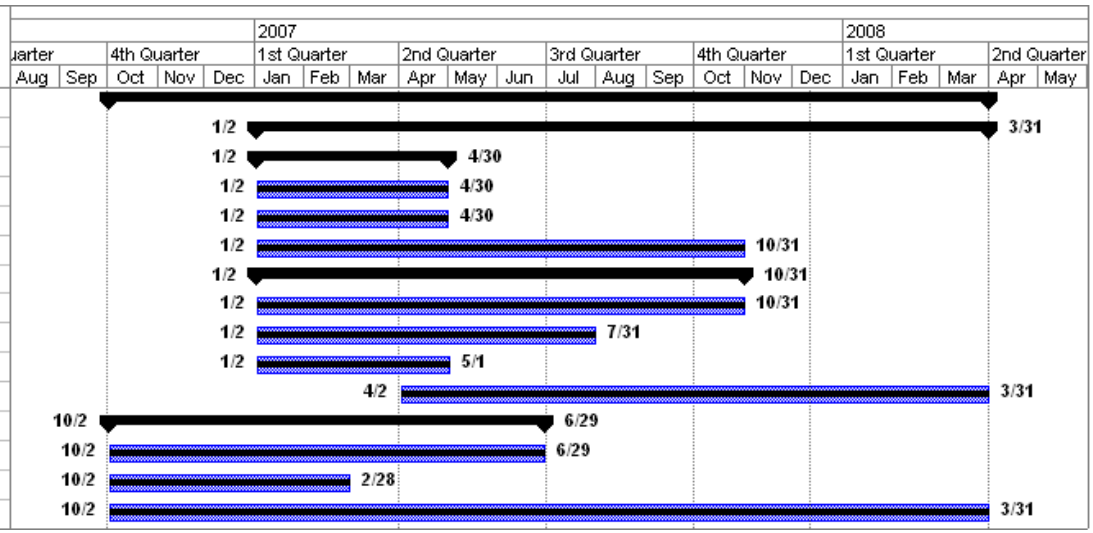
SNF Phase 2 Detailed Schedule
October 1, 2006 to March 31, 2008

ID	Outline Number	Task Name
1	**1**	**HLW Phase II**
2	**1.1**	**Geologic Repository Technologies**
3	**1.1.1**	**Site Characterization (ERL)**
4	1.1.1.1	Field Test Planning and Design
5	1.1.1.2	Data Interpretation Using nSIGHTS
6	1.1.2	Conceptual Model Development Methodology
7	**1.1.3**	**Flow and Transport Model Devel. & Apps (INER)**
8	1.1.3.1	Advanced Application of FEHM
9	1.1.3.2	GoldSim/INPAG/AMBER Linkage Capability Training
10	1.1.3.3	Simulation-based Ident. of Imp't Frac Net Parms
11	1.1.4	**Review/Comment on ERL/INER Tech Reports**
12	**1.2**	**Dry Storage Cask**
13	1.2.1	Dry Storage Cask Seismic Analysis
14	1.2.2	Dry Storage Cask Thermal Analysis Review
15	**1.3**	**Project Management**



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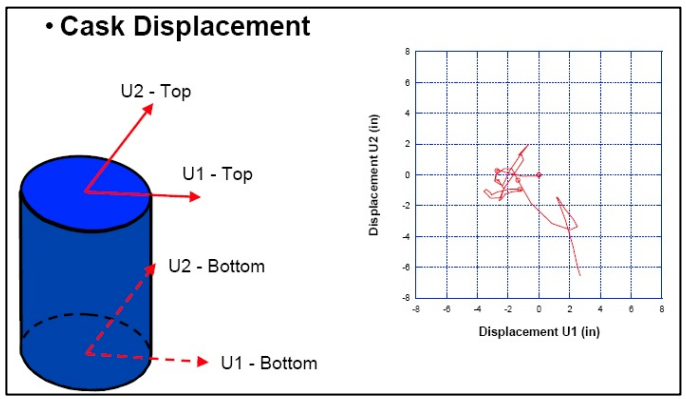
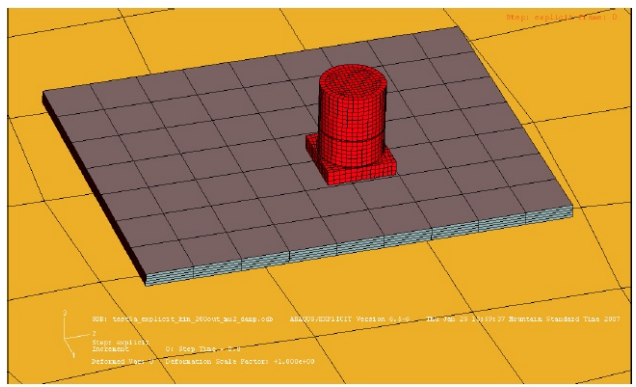
SNF Dry Storage – Seismic Analysis

Assist FCMA in review of SNF dry storage Safety Analysis Report (SAR) in the areas of seismic and thermal analysis; develop seismic analysis models; perform sample structural seismic analysis; conduct structural seismic analysis training; assist FCMA in interpretation of structural seismic analysis results.

- Seismic analysis sections of the Spent Nuclear Fuel Interim Dry Storage Facility SAR were reviewed and discussed at FCMA on February 6-9, 2007; final review comments were provided July 20, 2007.
- Seismic analysis sample models were prepared and delivered to FCMA on February 15, 2007.
- A workshop on soil-structure interactions for the facility was held at FCMA March 20-22, 2007.





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SNF Dry Storage – Thermal Analysis Review

Assist FCMA in review of the thermal analysis submitted as part of TPC's license application, and meet with FCMA to discuss review results.

- Thermal analysis sections of the Spent Nuclear Fuel Interim Dry Storage Facility SAR were reviewed and discussed at FCMA on February 6-9, 2007.
- A summary discussion transmitted February 26, 2007.

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Geologic Repository – Site Characterization

Assist EEL in further development of technologies used in site characterization.

1. **Field Test Planning and Design**

- *Site characterization data requirements were defined and provided to INER and EEL.*
- *Workshop on lessons learned from site characterization on WIPP, YMP, and other programs presented at INER the week of March 12-16, 2007 for INER and EEL personnel.*

2. **Data Interpretation Using nSIGHTS**

- *Workshop conducted on advanced applications of nSIGHTS for interpretation and analysis of well data collected by EEL was at INER on March 19-20, 2007.*

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Geologic Repository – Conceptual Models

Assist INER and EEL in developing capabilities for establishing conceptual models using site characterization data and information.

- Conceptual models for fracture network flow using example K-area data were developed and used to simulate groundwater transport using the FEHM code.

- Workshop held October 15-19, 2007 to discuss the development of conceptual models using site data and the application of the FEHM code.

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Geologic Repository – Flow and Transport

Assist INER in flow and transport model development and applications.

1. Advanced Applications of FEHM

- Training provided October 15-19, 2007 on use of FEHM for calculation of heat and mass transport, model calibration with site data, and adapting FEHM to site conceptual models.

2. GoldSim / INPAG / AMBER Linkage Capability Training

- DLLs for linking INPAG codes to GoldSim were developed and tested.
- Two technical reports, SAND2007-3362 and SAND2007-3368, User's Manuals for the linking DLLs, were issued.

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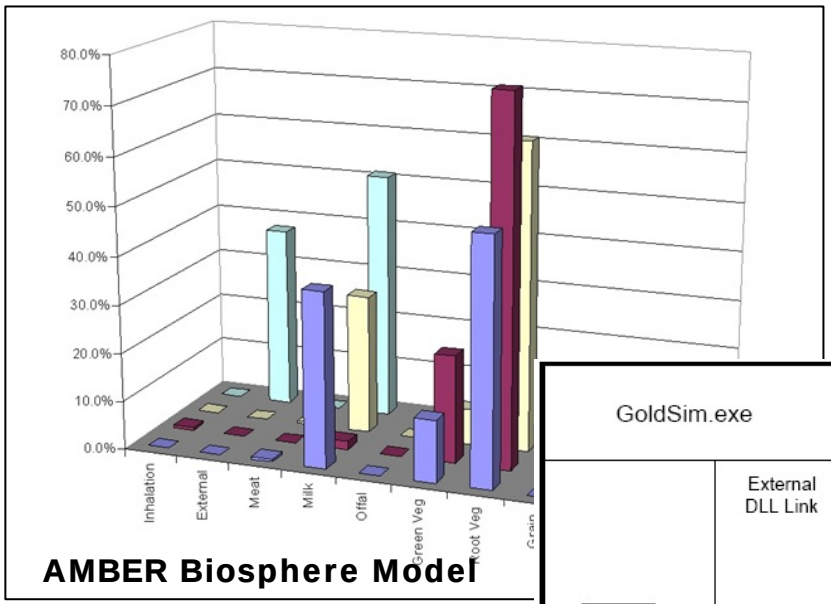
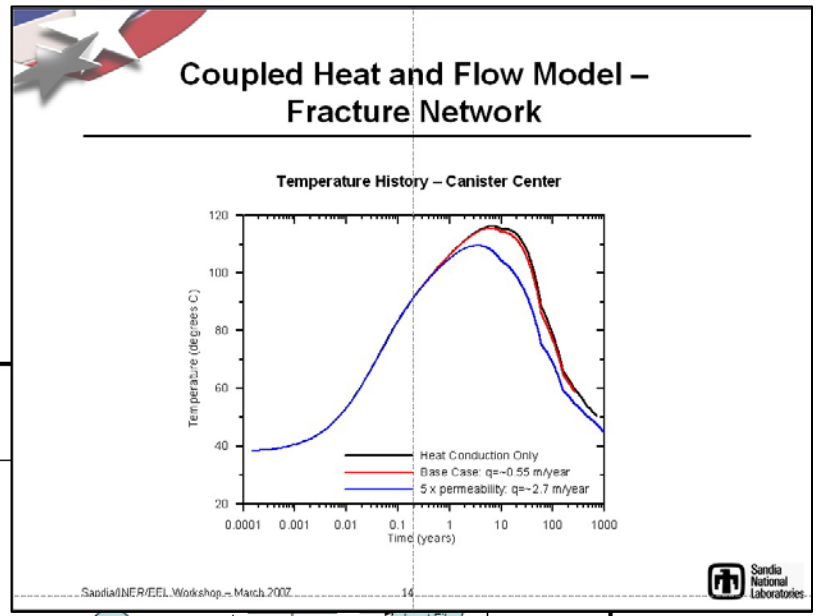
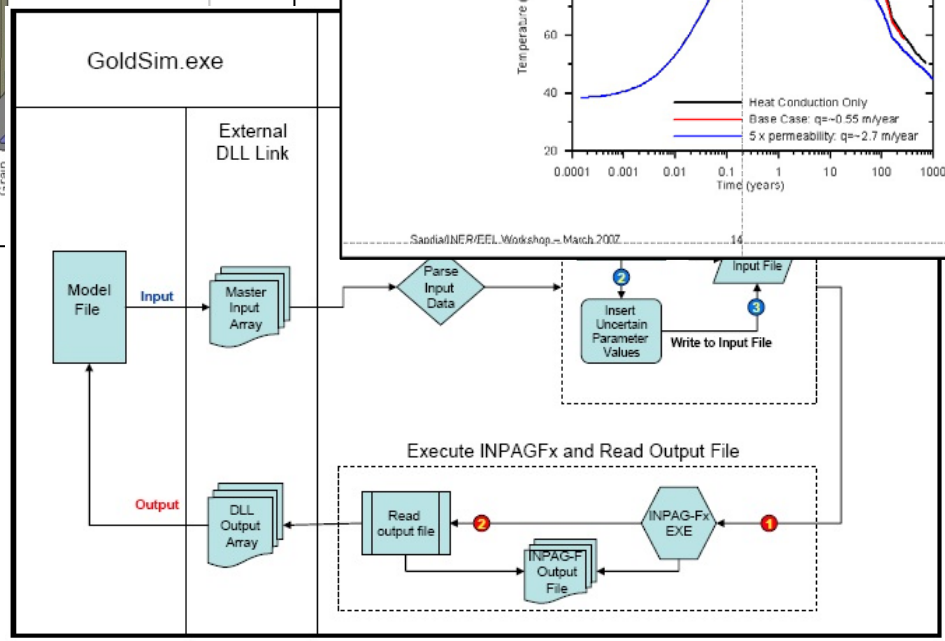
Repository Technologies



AMBER Biosphere Model





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Geologic Repository – Flow and Transport (continued)

Assist INER in flow and transport model development and applications.

2. GoldSim / INPAG / AMBER Linkage Capability Training (continued)

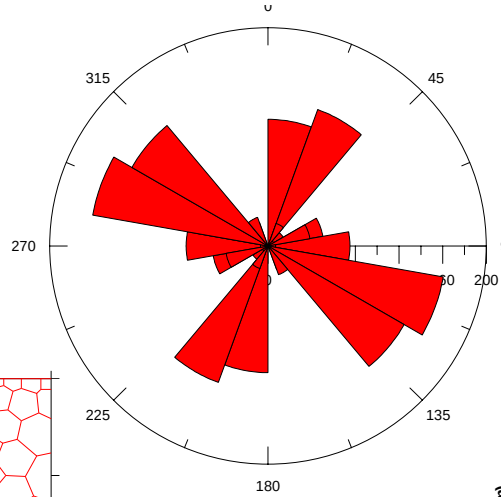
- The AMBER code was obtained and used to model release scenarios and to conduct sensitivity and uncertainty analyses for biosphere dose consequence assessments.
- Workshop held at INER June 21-28, 2007 to provide training on concepts of code linking, problem definition and modeling architecture, and biosphere modeling.

3. Simulation-based Identification of Fracture Networks

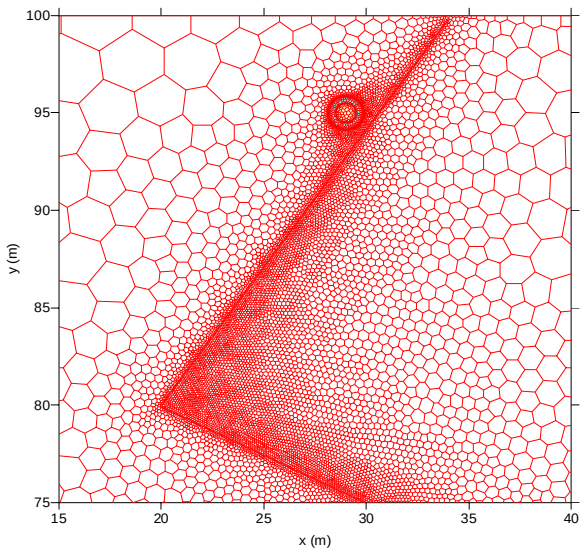
- Fracture simulation software used to calculate flow and transport solutions was incorporated into the October 15-19, 2007 workshop.

Advanced FEHM Conceptual Modeling

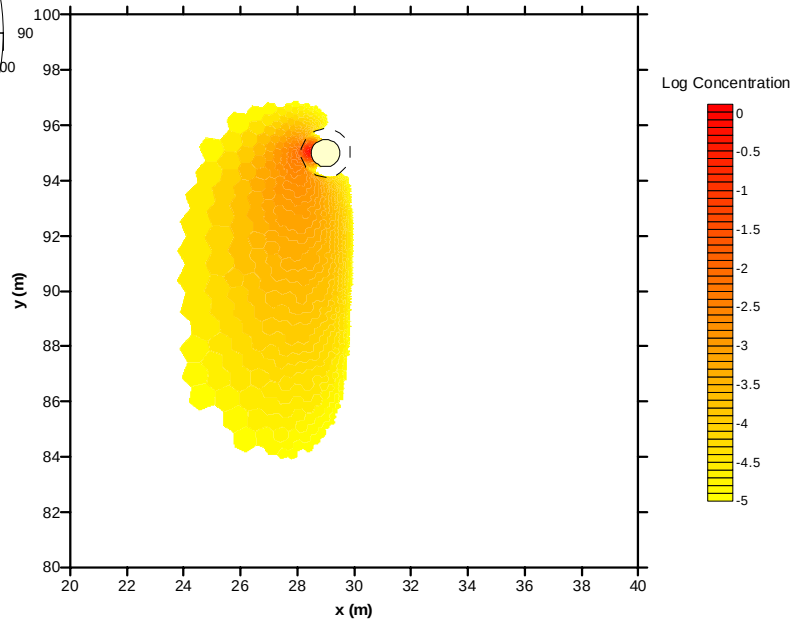
Fracture Network Conceptual Model



Voroni Mesh



Transport Simulation



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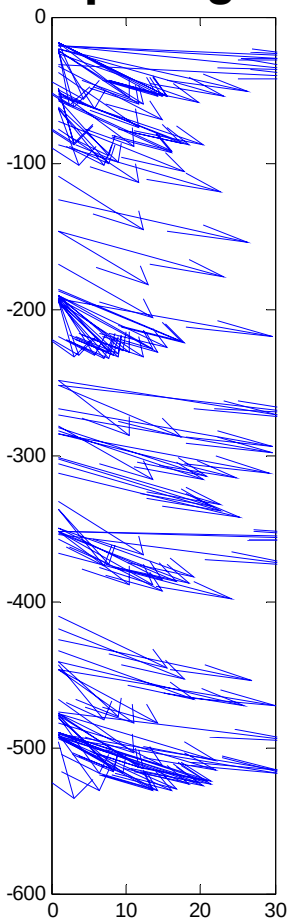
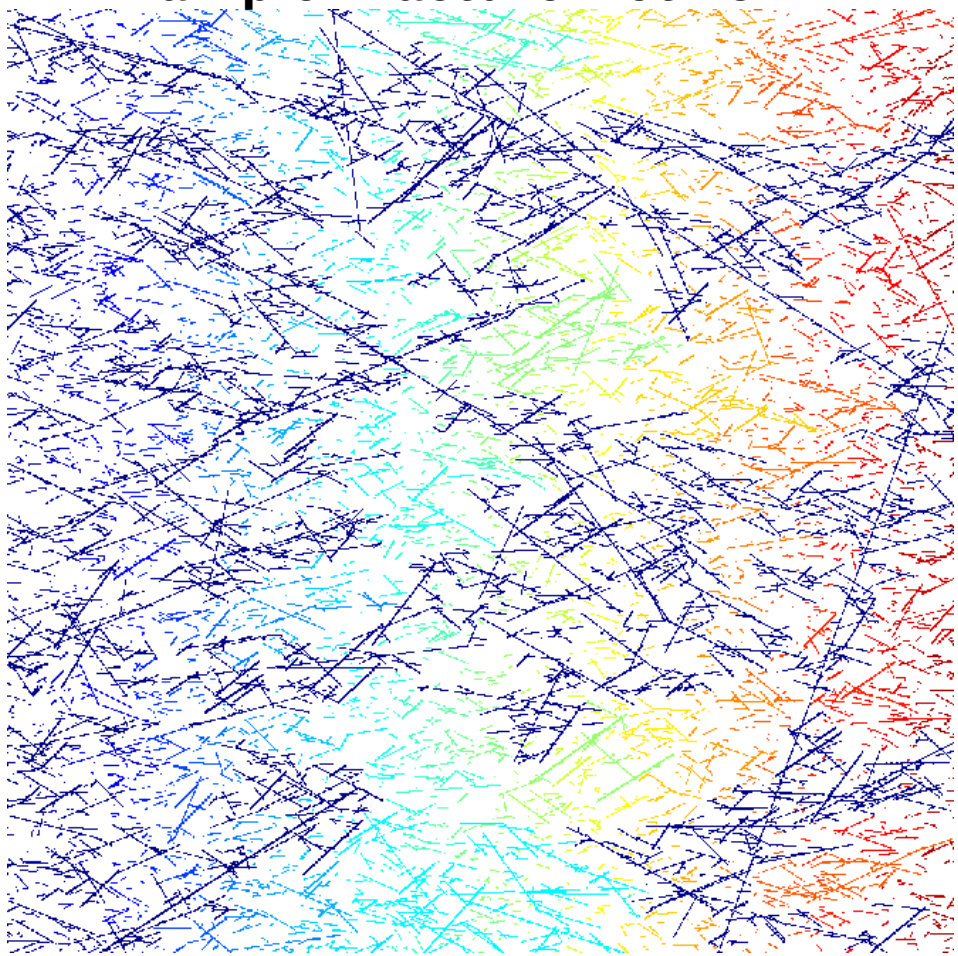
Fracture Network Simulation

Dip Angles



Example Fracture Network



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Geologic Repository – Technical Review

Review, comment, and provide technical input on EEL and INER technical reports.

- Review comments on four INER journal articles prepared and sent to the author.
  - "Hydrogeological characterization of the leaky confined aquifer overlaid on a basement rock"
  - "Contaminant transport with multiple-member decay chain in one-dimensional fractured or porous media: analytical solution in the LaPlace domain"
  - "Uncertainty propagation of hydrodispersive transfer in aquifer: An illustration of one-dimensional contaminant transport with slug injection"
  - "Storage of confined aquifers: Spectral analysis of groundwater head responses to earthquake Rayleigh waves"

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Geologic Repository – Technical Review (continued)

Review, comment, and provide technical input on EEL and INER technical reports.

- Review comments on INER CY06-07 progress reports for the spent nuclear fuel final disposal program were prepared and transmitted to INER in February 2008 and a meeting to discuss review comments was held in March 2008.

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Project Coordination and Management

Provide technical management and integration support to FCMA, INER, EEL, and other Taiwan organizations. Specific activities include: facilitate kick-off meeting, attend integration meetings, facilitate Taiwan integration, and coordinate US support.

- Kick-off meeting – September 29, 2006.
- Presentations made at the first East Asia Forum on Radioactive Waste Management (EAFORM) on November 27-29, 2007.
- Non-disclosure agreements between Sandia and FCMA and between Sandia and INER were signed in February and March 2007.
- Other coordination meetings held in conjunction with technical workshops and other meetings.
- Ongoing communication by use of a website (http://www.sandia.gov/icp/) for transmitting software and reports, email responses to requests for technical reports, etc.

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Phase II Recommendations

- **FCMA has developed the analytical capabilities for soil-structure interactions for a spent nuclear fuel interim storage facility. FCMA should maintain and continue to exercise these capabilities.**

- **Continue to improve project interface between INER and EEL. The good interface and integration between site characterization and performance assessment are critical to the success of a geologic repository program.**

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Phase II Recommendations (continued)

- **Both INER and EEL should continue to reach out to the international repository community by attending international conferences and establishing long-term collaborations. This would increase international recognition of Taiwan's repository program.**

- **Develop a fully integrated data base and information management system. This fully integrated data base would include all data collected in site characterization, experimental programs, and used in performance assessment.**

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