

## MOBILITY MISSION REPORT

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### MISSION TITLE

The 2nd GAS/HITEC Joint training course

### DESCRIPTION

#### Concerned organisations

Research entities (Lithuanian Energy Institute)

#### Concerned infrastructures or facilities

High-performance computing

Underground research laboratory

#### Concerned phases

Phase 1: Site evaluation and site selection

Phase 5: Post-closure

#### Themes and topics



- Theme 3: Engineered barrier system (EBS) properties, function and long-term performance
  - EBS system understanding
- Theme 4: Geoscience to understand rock properties, radionuclide transport and long-term geological evolution
  - Perturbations (gas, temperature and chemistry)
- Theme 6: Siting and Licensing
- Theme 7: Performance assessment, safety case development, and safety analyses
  - Integration of safety-related information
  - Performance assessment and system models

### Keywords

THM processes, constitutive models, gas flow, experimental testing, geomaterials.

## EXECUTIVE SUMMARY

As in other nuclear countries, the operation of the Ignalina NPP (INPP) in Lithuania has led to the accumulation of around 22 thousand of spent nuclear fuel (SNF) assemblies. A country's responsibility for the safe management of its SNF is acknowledged worldwide. Within the European Union (EU), directive 2011/70/EURATOM contains the provision for every member state (country) to be responsible for the implementation of the safe and sustainable solution for SNF and radioactive waste management and disposal. Currently, it is envisaged that Lithuanian SNF will be stored in dry interim storage facilities (new and existing) for at least 50 y prior to possible deep geological disposal. Some investigations of the possibilities to dispose of the SNF in Lithuania have been initiated.

Researchers of Nuclear Engineering Laboratory have been actively involved in the analysis of problems related to the management of radioactive waste from INPP since 1994. For this purpose, the Laboratory performs assessments of the release of radionuclides from waste repositories, safety assessments of waste treatment technological equipment, storage and disposal facilities, and environmental impact studies. Typically, the safety and performance analysis are supported with the numerical modelling of coupled thermo-hydro-mechanical processes.

Taking this training course increased competence in understanding and modelling complex coupled THM processes in geomaterials. It also expanded the competence in the experimental tests that are used to calibrate numerical models and verify results. The gained knowledge and skills will allow LEI to contribute to the analysis of THM processes in the geological repository within the framework of EURAD and EURAD-2 more effectively.

## 1. MISSION BACKGROUND

### 1.1. R&D background

Gintautas Poskas is involved in EURAD WP7 HITEC activities and performs modelling with COMSOL Multiphysics to assess influence of temperature on clay-based material behaviour. Participation in the Training course on multiphysics and multiscale coupled processes in geomaterials with a particular focus on thermal effects and gas transfer impact on the behaviour of geomaterials will broaden Gintautas Poskas knowledge about the safe RAW management and disposal.

### 1.2. Mission objectives

Participation of researcher Gintautas Poskas at a joint training course “The 2nd GAS/HITEC Joint training course”. To gain knowledge about the multiphysics and multiscale coupled processes in geomaterials with a particular focus on thermal effects and gas transfer impact on the behaviour of geomaterials.

### 1.3. Mission request

To cover the travel costs (1777 Eur) for the participation of dr. Gintautas Poskas in “The 2nd GAS/HITEC Joint training course”.

### 1.4. Mission composition

#### Host organisation

ULiege.

#### Host facility

ULiege, Mathematics Institute, Belgium.

#### Mission dates

28 August 2023 – 1 September 2023

## 2. MAJOR PRACTICES, TECHNIQUES, METHODS, TOOLS OR SYSTEMS OPERATED OR STUDIED

### 2.1. Practice, technique, method, tool or system operated or studied during the mission

The 2nd GAS/HITEC Joint training course.

#### Description

Lectures and presentations on multiphysics and multiscale coupled processes in geomaterials with a particular focus on thermal effects and gas transfer impact on the behaviour of geomaterials.

#### Usage

During these lectures the knowledge was improved about the multiphysics and multiscale coupled processes in geomaterials with a particular focus on thermal effects and gas transfer impact on the behaviour of geomaterials. The theoretical lectures were complemented with a technical visit to EURIDICE\_HADES underground research laboratory.

#### Benefits

The lectures and site visit broaden knowledge about THM processes and gas flow, constitutive models, modelling software, experimental data interpretation which will help in the future work on the safe RAW management and disposal.

#### Limitations

None.

#### Applicability

Participation in this training course expanded competence to evaluate the processes in geological repository. Gain knowledge will allow to continue development of numerical models for simulations of complex coupled THM processes in the repositories.

### 2.2. Practice, technique, method, tool or system operated or studied during the mission

#### Description

Usage

Benefits

Limitations

Applicability

2.3. Practice, technique, method, tool or system operated or studied during the mission

Description

Usage

Benefits

Limitations

Applicability

2.4. Practice, technique, method, tool or system operated or studied during the mission

Description

**Usage**

**Benefits**

**Limitations**

**Applicability**

### 3. MISSION FINDINGS AND CONCLUSIONS

#### 3.1. Lessons learned and conclusions

The mission provided an great opportunity to get effective training on the multiphysics and multiscale coupled processes in geomaterials with a particular focus on thermal effects and gas transfer impact on the behaviour of geomaterials. This training course enhanced my knowledge and skills about the multiphysics and multiscale coupled processes in geomaterials.

#### 3.2. Relevant findings and conclusions for home organisation

Taking this training course increased competence in understanding and modelling complex coupled THM processes in geomaterials. It also expanded the competence in the experimental tests that are used to calibrate numerical models and verify results. The gained knowledge and skills will allow LEI to contribute to the analysis of THM processes in the geological repository within the framework of EURAD and EURAD-2 more effectively.

#### 3.3. Relevant findings and conclusions for host organisation

#### 3.4. Relevant findings and conclusions for other organisations

## 4. POTENTIALS FOR IMPROVEMENT OR DEVELOPMENT

- 4.1. Generic potentials
- 4.2. Potentials for home organisation
- 4.3. Potentials for host organisation



## APPENDICES

### Mission journal

Monday 28 August

9.00 – 12.30 Basics of thermo-hydro-mechanical processes in geomaterials

13.30 – 17.00 Basics of experimental testing of geomaterials

Tuesday 29 August

9.00 – 12.30 Constitutive modelling of thermo-hydro-mechanical processes in geomaterials

13.30 – 17.00 From workflows towards Digital Twins: OpenWorkFlow-Project

13.30 – 17.00 Introduction to OpenGeoSys (OGS) and basics of Multiphysics simulations

Wednesday 30 August

13.30 – 15.00 Experimental multi-scale insight into gas transport and self-sealing capacity

15.00 – 16.00 Experimental testing of BCV bentonite

16.00 – 17.00 Visualising gas flow in the laboratory

Thursday 31 August

9.00 – 12.30 Advanced multiphysics modelling of geomaterials: multiscale approaches and heterogeneities

11:00 – 12.00 Multiscale (simplified) modelling of gas flow

12:00 – 12.30 Numerical modeling discrete gas pathways and cracking

13.30 – 15.00 In situ THM and gas experiments

15.00 – 15.30 In situ gas fracturing experiments conducted in the CO<sub>x</sub> claystone

15.30 – 16.30 the FEBEX in situ test: an 18-year long simulation of an engineered barrier

16.30 – 17.00 in situ THM testing at high temperature.

Friday 1 September

Technical visit to EURIDICE\_HADES underground research laboratory.

### Mission bibliography

## MISSION BENEFICIARY

Gintautas POSKAS  
Senior researcher  
Nuclear Engineering Laboratory  
Lithuanian Energy institute

## PARTNER EXPERTS CONTRIBUTING TO THE MISSION

### Host organisation experts

- Frédéric Collin Professor at University of Liège

### Home organisation experts

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### Other organisations experts

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## REPORT APPROVAL

Date	Beneficiary	Home mentor/supervisor	Host mentor/supervisor
Date of last signee	Gintautas Poškas	Povilas Poškas	Frédéric Collin