IGD-TP Joint activity: Handling of uncertainties

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Santa Fe

Background: IGD-TP

Implementing **G**eological **D**isposal of Radioactive Waste – **T**echnology **P**latform

www.igdtp.eu

"Our vision is that by 2025, the first geological disposal facilities for spent fuel, high-level waste and other long-lived radioactive waste will be operating safely in Europe."

Goals

- implementation-oriented R&D activities on all remaining key aspects of deep geological disposal of spent fuel and long-lived radioactive waste
- demonstration on the technologies and safety
- underpin the development of a common European(*) view on the main issues related to the management and disposal of waste

Founded as a European Technology Platform (ETP) to

- provide a framework [...] to define research and development priorities, timeframes and action plans on a number of strategically important issues
- play a key role in ensuring an adequate focus of research funding on areas with a high degree of industrial relevance
- address technological challenges that can potentially contribute to a number of key policy objectives

(*)*Non-European countries are welcome to participate!*

IGD-TP Strategic Research Agenda (SRA): Key Topics

1. Safety case

- 1.1 (HP): Increase the confidence in, testing and further refinement of the tools (concepts, definition of scenarios and computer codes) used in licensing safety assessments
- 1.2 (HP): Improving safety case communication
- 1.3 (MP): Increase the confidence in and further refinement on how to make sensitivity and uncertainty analyses

2. Waste forms and their behaviour
3. Technical feasibility and long-term performance of repository components
4. Development strategy of the repository
5. Operational Safety
6. Monitoring
7. Governance and Stakeholder involvment

IGD-TP Deployment Plan (DP): Joint Activities (JA)

JA types

- Organizational Working Group (ORWG)
- Technical/Scientific Working Group (TSWG)
  - developing a scientifical or technical Topic
  - preparatory work to generate a possible technical project (TEP)
  - to be initiated when the Topic's subject needs to be analyzed by a group of experts prior to being turned into a Technical Project (TEP)
  - members cover their own costs
- Information Exchange Platform (IEP)
- Technical Project (TEP)
  - activity that covers technical or scientific work on a specific SRA Topic
  - clear RD&D problem definition necessary
  - different funding models
- Technological Transfer (TT)

Both SRA and DP are being being revised and not yet available in final form!

IGD-TP Joint Activity 8

Handling of Uncertainties in the Safety Case for Deep Geological Repositories

(Former title: "Benchmarking" for confidence in long term safety in Safety Cases)

- Adresses mainly SRA topic 1.3
- Contribution to SRA topics 1.1 and 1.2
- TSWG founded

ANDRA (FR)	NRG (NL)
ENRESA (ES)	NWMO (CA)
Galson Ltd. (UK)	Posiva Oy (FI)
GRS (DE)	Sandia Labs (USA)
JAEA (JP)	SKB (SE)
NAGRA (CH)	SURAO (CZ)
NDA (UK)	TU-Clausthal (DE)
NIRAS/ONDRAF (BE)	UJV (CZ)

- TEP planned to be launched in 2015/2016

History of JA8 in IGD-TP

June 2012: IGD-TP Deployment Plan

- Definition of JA8:
  - „Benchmarking“ for confidence in Long Term Safety in Safety Cases: TSWG
  - Topic 1.3: Increase confidence and further refinement of methods to make sensitivity and uncertainty analyses

May 2013: 1st Meeting of interested organizations

- Foundation of a TSWG
  - ANDRA, ENRESA, Galson, GRS, JAEA?, NAGRA, NDA, NIRAS-ONDRAF?, NRG, NWMO?, POSIVA, SANDIA, SKB, SURAO, TU-Cl, UJV
- Definition of project contents
- Elaboration of an outline project structure

History of JA8 in IGD-TP (cont.)

July 2013: First draft outline proposal (Dan Galson)

- 8 tasks

August 2013: Second draft outline proposal (GRS)

- 4 WPs with 13 tasks, altogether

September 2013: 2nd Meeting of interested organizations

- Planning of activities of the TSWG
- New title of activity: “Handling of Uncertainties in the Safety Case for Deep Geological Repositories”

Motivation: Uncertainties in the Safety Case

- Are we investigating the right **scenarios**?
  - Are we using the right FEPs?
  - Are our FEP descriptions correct?
  - Do we assign the right probabilities to the FEPs?

- Are we using adequate **models**?
  - Do we model all relevant effects?
  - Are our models suitable for describing these effects?
  - Are the models sufficiently accurate?

- Will the **data** we use lead to reliable results?
  - Is our knowledge of nature good enough to justify the utilized data?
  - Can physically uncertain effects have an influence?

→ *Proper handling of uncertainties is an essential part of the Safety Case*

Handling of Uncertainties

- Scenario uncertainties
  - Identification of possible influences
  - Proper scenario analysis

- Model uncertainties
  - Identification of possible model uncertainties
  - Application of different model options
- Data uncertainties

- Quantification of data uncertainties
  - Deterministic parameter variations
  - Probabilistic analysis
    - uncertainty analysis
    - sensitivity analysis

Outcome and Recommendations from Former Projects PAMINA and MeSA

- Uncertainty analysis
  - Proposal for a systematic procedure to derive PDFs
  - Protocol to treat model uncertainties
  - These procedures should be further developed and tested in an international framework
  - Use of realistic Safety Cases
  - Experiences shared with other institutions could provide valuable guidance

- Expert judgement
  - Review of approaches was made
  - Necessary to examine such guidelines further
    - to determine whether and when more formal approaches to expert judgement are warranted
    - for system description and scenario derivation

- Probabilistic sensitivity analysis (SA)
  - Principle considerations of conventional and some modern methods for sensitivity analyses within the post-closure safety assessment of DGR
  - Robustness of various methods to handle non-linearities is quite different and the results are not always the same for all methods
  - More research work is needed to establish a reliable procedure for SA
  - An international frame would be needed for an efficient treatment of this task

2nd draft proposal: TEP: Confidence Building and Handling of Uncertainties in Safety Assessment for Geological Disposal Facilities

WP 1: Management of uncertainties

- Task 1.1: Strategies for managing uncertainty
- Task 1.2: Management of uncertainties in different time frames of disposal system evolution
- Task 1.3: Regulatory decision-making under uncertainty
- Task 1.4: Communication of uncertainty

WP 2: Uncertainty identification and quantification

- Task 2.1: Expert judgement
- Task 2.2: PDF derivation
- Task 2.3: Identification and quantification of correlations

WP 3: Sensitivity analysis

- Task 3.1: Survey and assessment of methods in view of PA
- Task 3.2: Comparison of methods by numerical experiments
- Task 3.3: R&D triggering

WP 4: Co-ordination

- Task 4.1: Work co-ordination
- Task 4.2: Training
- Task 4.3: International conference

Planned contributions of JA8 participants in 2014 and 2015

Work in2014/2015	Active support / provide input
WP 1: Management of uncertainties (Leader: Galson)	
Task 1.1: Strategies for managing uncertainty	NDA, Galson, Andra, SKB, TUC, Posiva
Task 1.2: Management of uncertainties in different time frames of disposal system evolution	NDA, Galson, Andra, SKB, Posiva, GRS
Task 1.3: Regulatory decision-making under uncertainty	Comment: to be done within EC project, in 2 years, when SSM and STUK finalized their reviews
Task 1.4: Communication of uncertainty	NDA (test in stakeholder dialogue), Galson, GRS?, Surao, UJV
WP 2: Uncertainty identification and quantification (Leader: NDA)	
Task 2.1: Expert judgement	NDA, Nagra? BfS?,Surao, Galson
Task 2.2: PDF derivation	NDA, GRS, SKB, Posiva, Andra, NRG(2015), Surao, UJV
Task 2.3: Identification and quantification of correlations	NDA, GRS, Andra, SKB
WP 3: Sensitivity analysis (Leader: GRS)	
Task 3.1: Survey and assessment of methods in view of PA	GRS: distribute overview report second half 2014
Task 3.2: Comparison of methods by numerical experiments	GRS, Sandia, Andra, TUC: distribute overview report second half 2014
Task 3.3: R&D triggering	Surao, UJV

Recent, Current or Planned Work related to WP 3

GRS:

- Compilation of an overview report on methods of sensitivity analysis
- Test and comparison of different methods
  - two generic repository systems in rock salt
- Identification of further methods to overcome identified problems

ANDRA:

- Benchmark tests of sensitivity analysis methods
  - repository system in clay (French concept)

Sandia:

- Detailed sensitivity analysis studies for Yucca Mountain site

Further Procedure and Outlook

Continue co-operation work within the TSWG on own cost until 2015/2016

- Specific sub-groups with common interest
- Topics as identified (cf. Table)

Schedule

- October 2014: IGD-TP Exchange Forum Kalmar (Sweden)
  - Presentation of on-going and planned JA8 work
- Spring 2015: Technical meeting
  - Presentation of results achieved in the working groups
  - Compilation of progress
  - Identification of topics for further international investigation
- September 2015: Description of topics for a potential TEP