Potential IGD-TP – IGSC Collaboration

3 November 2015
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OECD-NEA Integration Group for the Safety Case (IGSC)

Mission
The IGSC builds and documents the technical and scientific basis for developing and reviewing safety cases as a platform for dialogue amongst technical experts and as a tool for decision making.

Membership
Senior technical specialists and managers from national waste management programmes, regulatory agencies and research and technical support institutions.
IGSC methods of working

- Annual **plenary meetings** with in-depth discussion of emerging issues and trends
- **Technical workshops** to explore key topics in detail
- **Studies**, joint projects
- National programme safety case **peer reviews**

All backed by expertise of participating organisations, using external expertise from the scientific and academic communities as needed.
Report on IGD-TP / IGSC
Workshop on Handling Uncertainties in Safety Assessments
Hosted by RWM at Harwell, UK
23rd and 24th September 2015
Background to workshop

- Various interactions under IGD-TP task JA.8
- Known interest in topic amongst IGSC members
- But, previously no clear agreed way forward
- So, RWM volunteered to host one-off workshop on the subject:
  - to share current experiences
  - identify if further collaboration on this topic would be beneficial
  - IGSC colleagues invited
Workshop attendees

• 16 attendees
• 8 countries represented
Aims of workshop: 3 technical sessions

1. The quantification of uncertainty in uncertain parameters for modelling. The goal was to review existing approaches, demonstrate how bias may affect uncertainty quantification and consider practical tools to aid uncertainty quantification. (Led by RWM)

2. Modelling aspects in the context of handling uncertainties including a review of the use of the outcomes of the EC PAMINA project and what has been developed since. (Led by Nagra)

3. Sensitivity analysis – recent developments and applications of sensitivity analysis methods to repository performance assessment models. (Led by GRS)
Session 1: Uncertainty calibration

Weather questionnaire
The questions relate to quantities which are unknowable at the time the questionnaire is completed, but quickly become known definitively – and it can be used repeatedly without being re-designed.

It’s not really about the weather/climate – it’s about how well you are able to quantify uncertainty, how well you know what you don’t know!

Its value is that it is a way of giving feedback on this to highlight any biases.
Session 1: Results of the weather questionnaire

15 questions – participants asked to give a range they were 90% confident the true value would lie between.

Scored between 0 and 2, with 1 being ‘perfect’ calibration.

Visual representation more revealing! Good result – would expect 1 or 2 answers outside the green zone.

Under-confident – 0.597

Over-confident – 1.663

Well calibrated – 1.088
Session 1: Uncertainty quantifier spreadsheet tool
Session 1: Proposed next steps

- Document in a report a proposed approach to uncertainty quantification and treatment, including multi-level approach, relation to management system and modelling approach, and the Uncertainty Quantifier tool
- Seek feedback – your views most welcome, also academics, regulators
- Is it possible to design a research project to demonstrate whether use of the tool (compared to a simple question asking for ranges) produces more accurate quantification of uncertainty – using parameters that can be known e.g. weather statistics?

Goal – an effective, intuitive, proportionate and well explained methodology for uncertainty quantification that is accepted internationally, by academics and used outside our own application
Session 2: Modelling aspects

• EC PAMINA project developed various techniques, some of which have been further extended and developed (e.g. by Nagra), but not all have been publicly documented
  – What problems are outstanding?
  – Where can value be added?
  – Where would collaboration be fruitful?

• Goal of this session was to take stock of progress since the EC PAMINA project and identify areas where further work may be needed
Session 2: Hierarchy of models used in safety assessment

Safety indicators

System-level models
(near-field, geosphere, biosphere)

Process-level models
(subsystem models, process models)

Knowledge and data

NEA MeSA initiative (2012), Fig. 6.1
Session 2: Open questions?

A few findings from the NEA MeSA initiative

• “Overall, there is wide consensus on the modelling strategies to support a safety assessment and no major areas of disagreement have been identified”

• Three classes of models often used in safety assessment:
  1. Process models (often used to calculate inputs for system models)
  2. Total system models or PA models
  3. Insight models (simpler models, often used to enhance system understanding)

• Is there a trend for ever-increasing integration of process models into system models?
  – Is this a positive or negative thing?
  – What does it mean for the handling of uncertainties and the evaluation of the importance of uncertainties?
Session 3: Sensitivity analysis

• Session dedicated to recent developments and applications of sensitivity analysis methods to repository PA models
• Aim to identify what can be learned from recent developments and which techniques are most effective and reliable
• Three presentations:
  1. Recent trends in sensitivity analysis (Elmar Plischke, TUC)
     • Analysis of input and output data in absence of model
     • Identification of hidden parameter dependencies and potential model errors
     • Visualisation techniques
  2. Sensitivity and probability analysis of the safety of deep geological repositories in crystalline rock according to the Czech concept (Aleš Vetešník, CTU)
     • GoldSim model, with variance-based and fuzzy set theory sensitivity analysis
     • Salt model, exhibiting non-linear and non-monotonic behaviour, making sensitivity analysis difficult
Session 3: Sensitivity analysis discussion

• A number of techniques were pioneered by PAMINA and some of these have been further developed
  – Would it be useful to conduct a review of the new techniques?
• How should we test for ‘false positives’?
• How can correlated input data be treated in sensitivity analyses?
• What is the best way to present the results of sensitivity analyses?
  – What is the best way to visualise the results of such analyses (CSM plots, cobweb plots, scatter plots, importance rank plot …)?
• Is it possible to produce guidelines or a ‘practitioners handbook’ to define a standardised approach to sensitivity analysis?
• Would such guidance help to convince a regulator or other stakeholders that appropriate techniques have been used?
Agreed workshop outcomes

• All participants agreed workshop had been extremely worthwhile, with excellent information exchange and discussion

• Good range of tools exist, but they need to be tested in safety assessment applications

Next Steps

• Specific areas for information exchange and collaboration between certain participants were identified (e.g. use of US datasets by GRS to test sensitivity techniques)

• Wider collaboration on methods for quantifying uncertainty for practical use in safety assessments would be valuable…
  – Ultimate goal: Development of an effective, intuitive, proportionate and well-explained methodology for uncertainty quantification that is internationally accepted (whilst not prescriptive) and ideally used both within and outside radioactive waste management

• Agreed to discuss with IGSC and IGD-TP
Potential IGSC collaboration: Working Group on handling uncertainty

- Workshop outcomes presented to IGSC on 6 October 2015
- IGSC members from following organisations expressed desire to join such a group
  - Posiva, Finland
  - Nagra, Switzerland
  - GRS, Germany
  - Niras-Ondraf, Belgium
  - SKB, Sweden
  - TUC, Germany
  - RWM, UK
  - USDoe (Sandia), US
Suggested way forward

- IGSC task group to develop proposals for further work based on workshop outcomes
- Consider:
  - methodology for uncertainty quantification as input to safety case
  - analysis of uncertainty in safety case outputs (sensitivity analysis)
- Welcome thoughts and input from the IGD-TP
- Aim for closer working and sharing of expertise between IGSC and IGD-TP
Thank you!

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