LESSONS LEARNT FROM 25 YEARS OF EXPERIENCE WITH PA/SA EXERCISES IN THE EUROPEAN UNION

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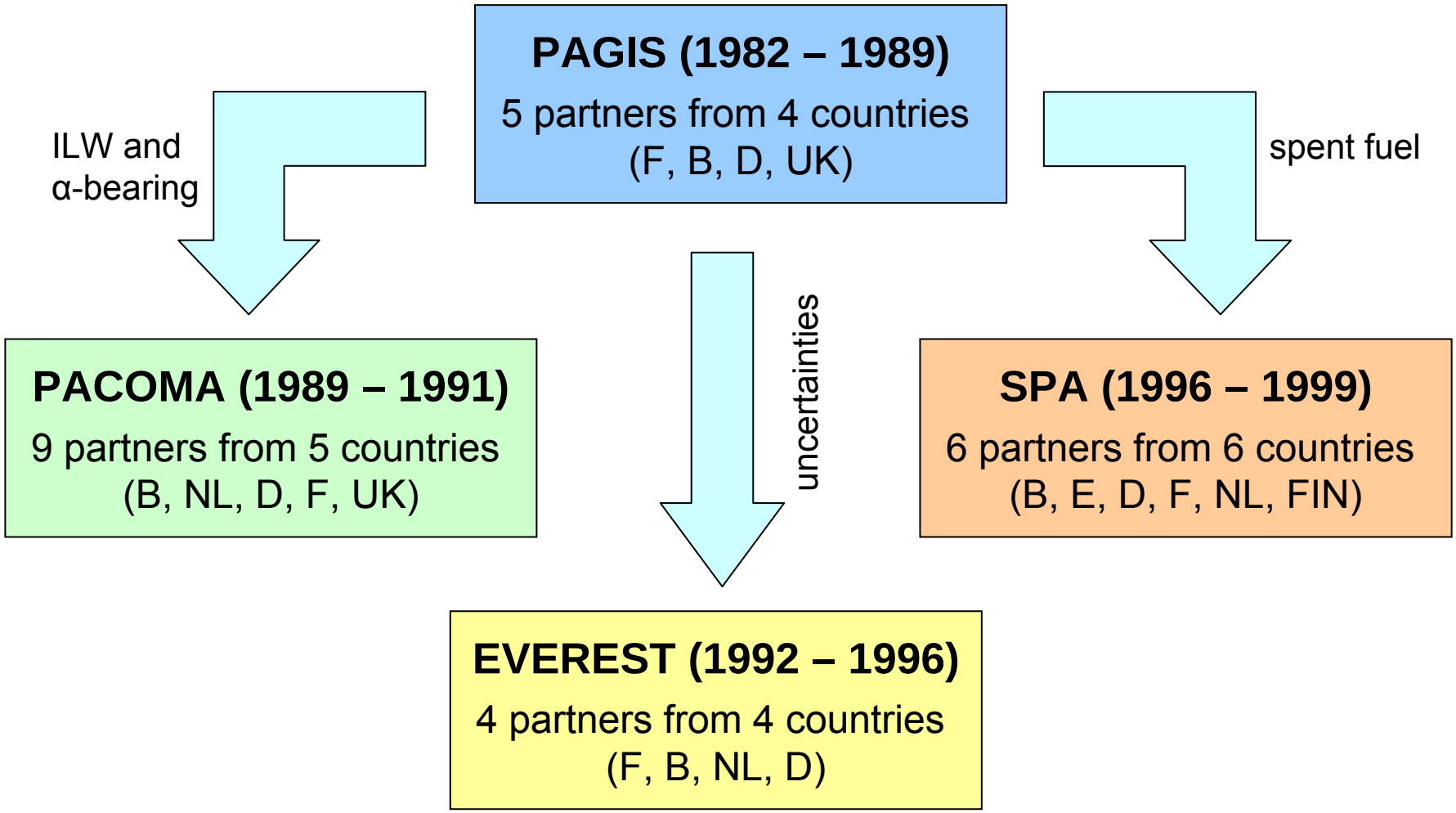
Introduction

- R&D work on the European level was continuously performed over the last 25 years
- Based on evolution of national programmes, PA/SA studies are in different stages of maturity
- Variations in many details and parameters owing to national programmes (waste type, type of containers, inventory, source term, geosphere properties, treatment of biosphere)

The Early Years – From PAGIS to SPA



From PAGIS to SPA – Main Findings

- Safe disposal of all types of radioactive waste in any formation possible
- Common methodological approaches and terminology helped to generate results that could be compared / discussed
- Utilisation of common models / data for near field allows for better understanding of the geosphere
- Biosphere modelling introduces a large variability into results
- Improvement of PA submodels via joint projects with process modellers
- A preservation of common methodologies is very valuable and should be given appropriate attention

The Broader Perspective

SPIN
(2000 – 2002)

BioClim
(2000 – 2003)

BioMoSa
(2001 – 2003)

Ecoclay II
(2000 – 2003)

Benipa
(2000 – 2003)

RETROCK,
GasNet, NaNet

Benchpar
(2002 - 2004)

PAMINA
(2006 – 2009)

Additional Safety and Performance Indicators

- Project SPIN (2000 – 2002)
  - eight partners from seven countries (D, ES, CH, NL, CZ, B, FIN)
  - four studies, only granite
- Systematic analysis and testing of possible indicators for use in different time frames
- Definition of basic requirements and assessment basis
- Three (out of 7) safety indicators useful for all time frames
  - effective dose (early time frames)
  - radiotoxicity conc.in biosphere water (early/medium time frames)
  - radiotoxicty flux from geosphere (late time frames)
- Reference values are basic problem for safety indicators

Biosphere-related Projects

- BioClim (2000 – 2003)
  - 12 partners from 7 countries (F, UK, D, E, CZ, F, B)
  - Scientific basis and practical methodology for assessing potential impacts of long-term climate change on biosphere characteristics
- Main conclusions:
  - Generalised environmental change scenarios based on narratives of climate change scenarios are useful to provide coherent descriptions and conceptual models of RN migration from geosphere to biosphere
  - No major requirement for climate research in direct support of PA identified
  - Climate modelling results provide substantial basis for PA in various regions of Europe

Biosphere-related Projects (II)

- BioMoSa (2001 – 2003)
  - Development of scientifically justified biosphere models
  - Five site-specific and generic biosphere models were derived (following BIOMASS methodology)
- Main findings:
  - BIOMASS methodology for setup of reference biosphere models useful starting point
  - Intake of drinking water is a very important or even dominating pathway for all sites (baseline)
  - Narrow dose distribution for most nuclides (except Se-79), since intake constrained by physiological factors

Relevance of THMC processes - hard rock formation

- Developing a discrete fracture network representation from field data is challenging. Resulting effective permeability of rock mass may vary considerably depending on asumptions
- Stress-permeability relations are very important
- THMC processes relevant in the resaturation and heating phase (first few hundred years)
- Uncertainty in analyses of flow stem from
  - the characteristics of fractured media and the associated spatial variability
  - and nature and degree of coupling rock mechanics and the hydraulic characteristics of fractures
- Upscaling of hydraulic properties is another main source of uncertainty (rather than T and M couplings)

Relevance of THMC processes - clay formation

- THMC processes important in the thermal phase
- Compilation of all FEPs which may affect performance of bentonite barrier
- Reactive transport models or THM models not yet ready to be implemented as main modelling tool in PA
  - supporting data incomplete
  - upscaling may be qustionable
  - models do not supply all integrated PA relevant information
- Bentonite barriers achieve functions in conjunction with other EBS, sensitive parameters have been identified
- Impact of cement on repository performance insignificant
- Uncertainties exist regarding mechanism of gas migration in bentonite buffers / clay formations

Lessons Learnt

- A preservation of common methodologies / terminology is very valuable and should be given appropriate attention
- PA model complexity should be consistent with the available data base
- Simpler PA models facilitate uncertainty analysis, are more transparent and easier to communicate
- Justification of basic assumptions in PA is essential and rests on detailed process analysis
- Numerical process level modeling should include the most important THM(C) components and followed by solute transport modelling

Lessons Learnt (II)

- Significance of different assumptions inherent in problem idealisation and input parameter values should be assessed by sensitivity studies
- BIOMASS methodology with some minor modifications is suitable for characterising biosphere states and for analysing transitions
- Thematic network projects are helpful to evaluate the present treatment of specific issues in safety assessments

Summary

- PA specialists from all countries performing PA/SA related work are sucessfully brought together, thus creating a critical mass that allows
  - to develop further ideas and concepts
  - to generate added value for participants and other stakeholders
- Collaborative work on issues by PA and process modellers substantiates scientific plausibility of PA models
- The scientific results and conclusions of the EU R&D projects on PA issues represent an important resource for national organisations
- The European projects provide important feedback by applying / discussing the framework established by the NEA guidance