INTEGRATION GROUP FOR THE SAFETY CASE (IGSC)

15-17 Octobre 2003
Paris - France

Application of Safety Assessment Methodology for Near Surface Waste Disposal Facilities

ASAM

Regulatory Review Working Group

Safety Case

V.Nys (Belgium)

ASAM
Regulatory Review Working Group

- **ASAM Background**
- **ISAM Methodology**
- **Safety Case**
- **Conclusions**

ASAM RRWG Background

- 1st Research Coordinating Meeting, 11 to 15 November 2002, Vienna, Austria
  Group leader : C. Torres (Spain)– 18 countries – 29 participants
- Intermediate Consultant meeting, 17 to 21 March 2003, Vienna, Austria
  Group leader : B. Belfadhel (Can) – 5 countries – 7 participants
- 1st Joint Working Group Meeting, 2 to 6 June 2003, Vienna, Austria
  Group leader : C. Torres (Spain)– 10 countries – 12 participants

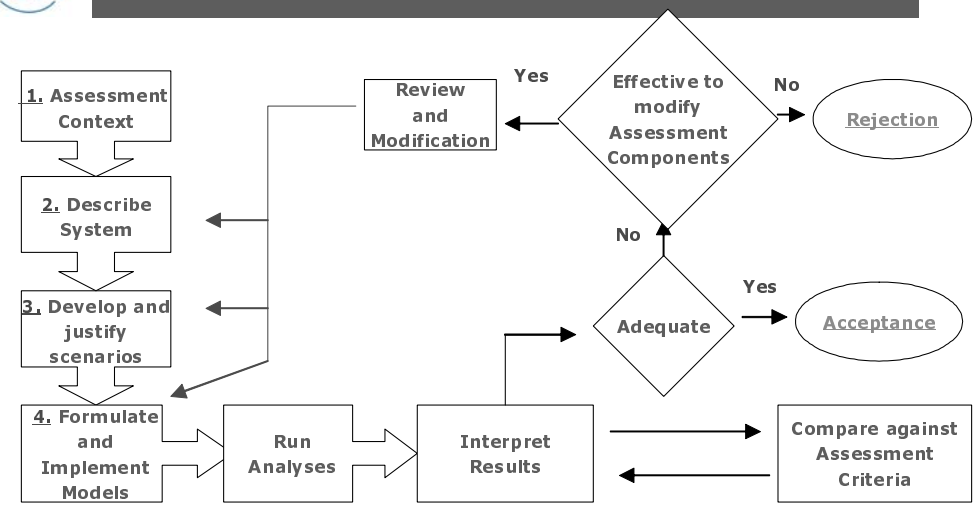
ASAM RRWG Work Plan

- Activity 1: Regulatory Review of post-closure safety assessment
  - Review of National and International Approaches for regulatory review of safety assessment for near surface disposal facilities
  - Development of guidance/procedure for regulatory review of safety assessment
  - Illustration of the review procedure
- Activity 2: Safety Case
  - Definition and identification of components of the safety case for **review**
  - Integration of safety assessment in safety case
  - Development of review procedure for the review of safety case
  - Illustration of the review procedure
- Activity 3: Confidence building
  - Review of existing documentation
  - Guidance on building confidence in different steps of safety assessment process

ISAM

Improvement of Safety Assessment Methodologies for near-Surface Disposal Facilities

ISAM Methodology



ISAM Safety Assessment Content (1/2)

Safety Assessment Context (1)

1. Assessment Context

- A description of the Safety Strategy
  - Objectives
  - Safety principles
  - Safety Functions
- A set of high-level assumptions
  - Timeframes
- A description of the regulatory framework
  - Radiological Protection criteria
  - Additional guidance
  - Waste acceptance criteria
- The purpose and the focus of the Assessment
  - Stage of the development (site, design, construction, operation, closure)
  - Assess the level of safety based on the currently available data
  - Identify the most important uncertainties
- The assessment end points

ISAM Safety Assessment Content (2/2)

Safety Assessment Context (2)

1. Assessment Context

- Stakeholders
  - Regulators
  - Decision makers
  - Other like Publics
- A brief description of the disposal system
  - Facilities
  - Types of wastes
- Planning
  - Building
  - Operational
  - Closure

ISAM System Description (1/4)

2. Describe System

- Site and Environment features
  - Geography
  - Geology and Hydrogeology
  - Natural Resources
  - Demography and Biosphere
- Waste Inventory
  - General Description (main producers, waste fluxes)
  - Waste Inventory
  - Traceability

ISAM System Description (2/4)

2. Describe System

- Facility Design and Building
  - General Design Basis
  - Individual description of each safety related building with its components
- Operation phase
  - General Description
  - Site Waste Package Acceptance
  - Handling
  - Waste disposal management
  - Monitoring and surveillance

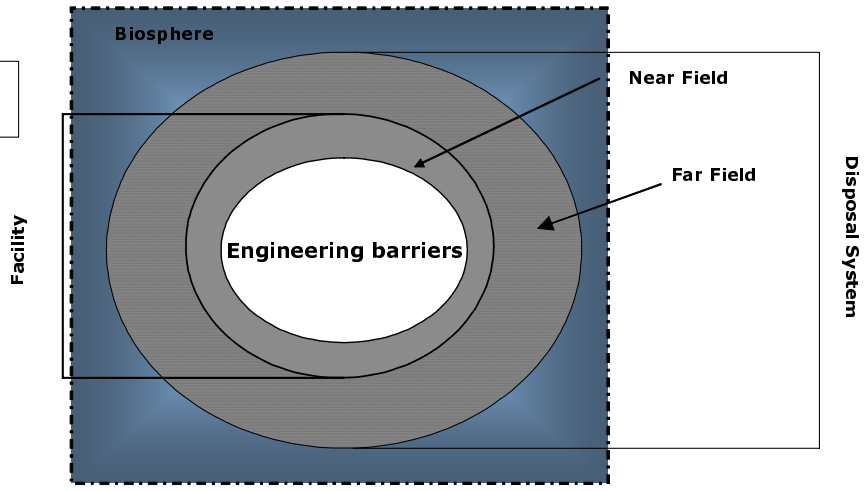
ISAM System Description (3/4)

2. Describe System

- Facility Closure
  - Closure planning
  - Description of the covers layers
- Institutional phase
  - Monitoring and surveillance
  - Active to passive transition
  - Measures during passive institutional control

ISAM System Description (4/4)

2. Describe System



ISAM Scenarios Development

- Description of the used methodology
  - Generic, Specific or Postulated Scenarios
  - Reference and Alternatives Scenarios

3. Develop and justify scenarios

- FEP's list
  - Screening of the Fep's list (external factors, disposal system, radionuclide factors)
- Design scenarios (reference and alternatives scenario including human intrusion scenario)
  - Operational Phase
  - Institutional Phase
  - Post Institutional Phase

ISAM Models implementation

- Conceptual Model Development
  - Depending of the contaminant pathways
- Identification of the safety related characteristics of each component
- Identified data depending of the safety related features of each component
- Stylization of the system or component
- Adequacy of the conceptual model with the design component

4. Formulate and Implement Models

- Adequacy of the physical phenomena and the mathematical models or their implementations
- Selection of appropriate computer tools (e.g. codes)

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Assessment of Safety Assessment Methodologies for near-Surface Disposal Facilities

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Confidence in the Safety Assessment
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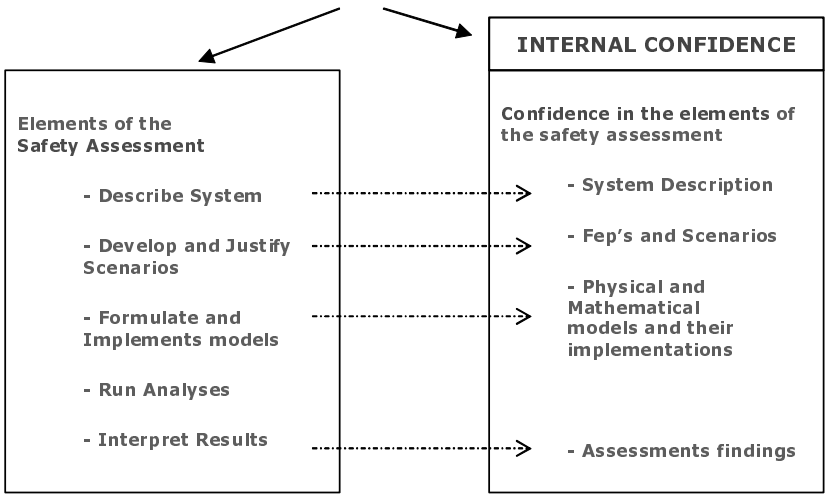

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Confidence in the Safety Assessment (1/3)

Confidence in each stage of the safety assessment

- Assessment context stage
  - The implementer should demonstrate sound and complete understanding of the key components of the assessment context and how these keys elements are integrated in the safety assessment
- Description of the system
  - The implementer should gain and demonstrate confidence in the engineering and natural aspects of the system and explain how uncertainties have been considered.
- Development and justifications of the scenarios
  - The implementer should demonstrate that the set of scenarios developed is credible, comprehensive and has been developed in a systematic, transparent and traceable manner.

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Confidence in the Safety Assessment (2/3)

Confidence in each stage of the safety assessment

- Formulation and Implementation of models
  - The implementer should demonstrate that the conceptual models and associated data are consistent with the assessment context, the disposal system and with the scenarios to be investigated.
- Analysis of the results
  - The implementer should demonstrate : a thorough understanding of the underlying science and engineering science, which are governing the safety assessments results, that associated uncertainties have been adequately considered and compliance with the regulatory requirements and recommendations set out in the assessment context has been analyzed

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Confidence in the Safety Assessment (3/3)

Confidence in each stage of the safety assessment

- Review and modifications
  - The implementer should demonstrate that the review of proposed modifications is based on a transparent prioritization process and that modification of any of the assessment components is justified and conducted in a structured manner.

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SAFETY CASE

- Does confidence in each separate module implies the confidence in the whole set ?
- Is the Internal Confidence sufficient?
- What about the "Multistep Process"?

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Safety Case

- A Safety Case appears to be the solution to these questions
- Its structure could be defined as …

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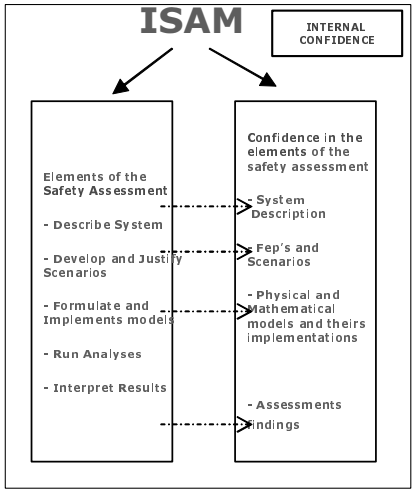
ASAM Safety Case Content



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- Global Statement of Confidence in the Findings
  - Approach
  - Methodology
  - Findings
- Confidence in the Management (Regulatory and Implementers) Framework
- Identification and Handling of unresolved issues
- Good engineering and robustness
- Alternative Options or Projects
- Communicating confidence to stakeholders

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ASAM Safety Case Content

Inside a step, ASAM Safety Case content could be proposed as compound of :

Safety Assessment as defined by ISAM with the internal confidence (*)

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- Statement of confidence

- Confidence in the Managerial Frameworks

- Identification and handling of unresolved issues

- Good Engineering and Robustness of the System

- Existing of alternative options or projects

- Communicating confidence to the Stakeholders

(*) ISAM Assessment Context should contain a clear description of the Safety Strategy

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ASAM Safety Case Global Confidence (1/3)

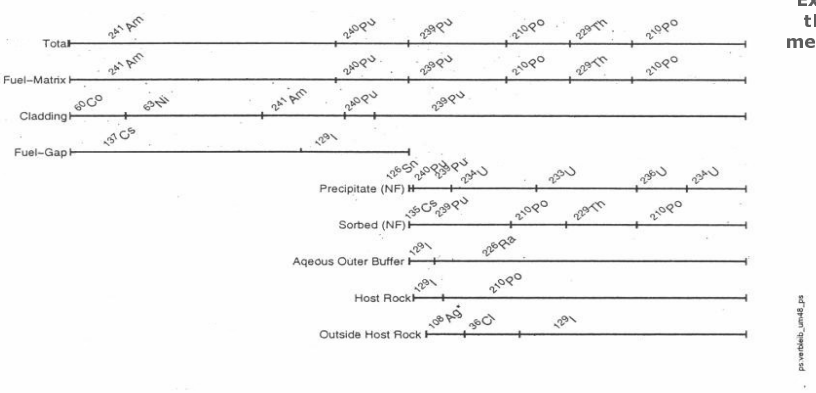
Global Confidence

- Methodology
  - A well defined and rational assessment methodology have been followed (systematic, transparent and traceable)
  - Compatibility of method with international experience
- Approach
  - Multiples lines of reasoning,
  - Safety indicators,
  - Variety of assessment techniques,
  - Complementary safety assessment
- Findings
  - All relevant data and information and their associated uncertainties have been considered
  - All key safety-related issues are identified and addressed (completeness of the study)
  - Peer review and comparison with assessment results from other similar sites
  - Checking of the coherence of the results with assumptions, codes validity range, ..

Regulatory Review Working Group ASAM Safety Case Example of Global Confidence (2/3)

Safety Indicators

Example from the 3rd IGSC meeting NAGRA



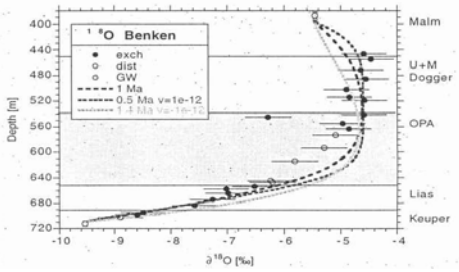
Note: Bars beneath the graph indicate the radionuclides that make the highest contribution to radiotoxicity at any particular time and in any particular part of the system

Regulatory Review Working Group ASAM Safety Case Example of Global Confidence (3/3)

Findings checking of the coherence

Example from the 3rd IGSC meeting NAGRA

Figure 9. Isotope concentration profiles across the Opalinus Clay (OPA) and adjacent rock strata, comparing measured data obtained under different conditions (labelled "exch", "dist" and "GW") and preliminary modelling results assuming diffusion only (blue lines), diffusion and upwardly directed advection (red lines) and diffusion and downwardly directed advection (green lines). The times in the legend indicate how long the model system has been allowed to evolve from an assumed initial state of uniformly high concentrations in the Dogger, OPA and Lias and the fixed present-day (lower) concentrations in the Malm and the Keuper in order to produce the three curves. v is the assumed advection velocity in ms^{-1}.



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ASAM Safety Case Management Framework

Management Framework

- **Clear management procedures, competent personnel, etc.**
- **Clear regulatory framework and guidance**
- **Well defined regulatory process and decision points (incl. review procedures)**
- **Adequacy of the management structure of the implementers and the regulator**

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ASAM Safety Case Robustness (1/2)

Good engineering and Robustness

- Multiple barriers and safety functions (e.g. containment, isolation)
- Confidence in the data and knowledge of the site
- Sensitivity studies of the whole set through the use of What-if scenarios

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ASAM Safety Case Robustness (2/2)

Good engineering and Robustness

- Latent "Safety Functions" of components
- *Intrinsic robustness* is acting on hazard perturbations through siting and design provisions
- *Engineered robustness* is to conceive a system such that the system is able to resist against hazard. Over dimensioning a barrier is an example.

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ASAM Safety Case Unresolved Issues (1/2)

- Identification and handling of unresolved issues
  - Strongly dependent of the considered phase
  - Identified uncertainties that could be reduced
  - Identified irreducible uncertainties
  - Rely on a well safety-related understanding

By this item, the "Multistep Process" could be addressed.

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ASAM Safety Case Unresolved Issues (2/2)

Examples :

- No specific scenarios are considered in a "siting phase"
- Chemical, Physical and Mechanical long-term concrete behavior
- Impact of the stylized modelisation

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ASAM Safety Case Alternatives

- Alternative of the disposal facility (risk of non-acceptance)

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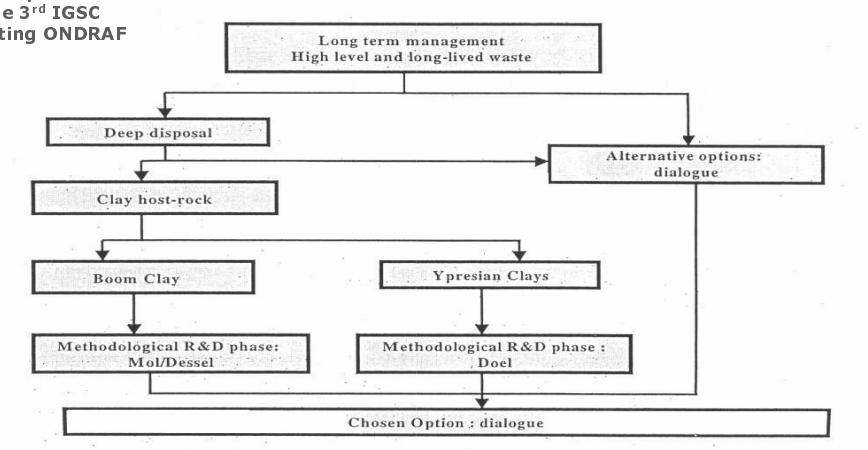
ASAM Safety Case Example of Alternatives

The figure 1 hereafter shows the successive steps of the process in order to open the dialogue on the chosen option.

Example from the 3rd IGSC meeting ONDRAF



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ASAM Safety Communicating Confidence

Communicating confidence to the stakeholders

- Technical aspects are necessary but not sufficient when communicating
- Identify Stakeholders – their interests and respective roles
- Define the role of the regulator with any other regulatory bodies and the implementers in the context of communication
- Different approaches for presentation of the safety case

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ASAM Safety Case

CONCLUSION

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Conclusions (1/2)

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Regulatory Review Working Group Conclusions (2/2)

- The first step of identification of components of the Safety Case is nearly done
- The next step will be to develop a review procedure for a Safety Case and illustrate it