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# **The Post-Closure Radiological Safety Case for a Spent Fuel Repository in Sweden**

**An International Peer Review of the SKB license-  
application study of March 2011**

**Presentation of the results  
June 13<sup>th</sup> in Stockholm / June 14<sup>th</sup> in Gimo**

# Cornerstones

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- Requested by the Swedish Government from OECD/NEA
- Start of the **International Review Team (IRT)** after submission of the “SR Site” by SKB in March 2011
- Final IRT report in June 2012
  
- **“SR Site”** is the Safety report regarding long-term safety for the “Application for license under the Nuclear Activities Act for construction, ownership and operation of a nuclear facility for the final disposal of spent nuclear fuel and nuclear waste”
  
- **“ToR”**: IRT mission goals fixed in “Terms of Reference for an International Peer Review of SKB’s Post-Closure Safety Reporting for a KBS-3 Repository”

# Disclaimer

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- The [purpose of the International Peer Review](#) is to help the Swedish government, the public and relevant organizations by providing an international reference about the maturity of SKB's spent fuel disposal programme vis-à-vis the best practice of long-term disposal safety and radiation protection.
- The International Peer Review is not a formal part of the Swedish licensing or decision-making process. [The IRT has not to decide on SKB's application](#). It is on the Swedish Government and the relevant Swedish Authorities to decide on SKB's application.

# International Review Team (1)

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- The IRT was assembled independently by the NEA.
- IRT members were not, and have not been, involved either for SKB, or for Posiva (SF), in developing the disposal method or safety case. Rules are fixed in the Terms of Reference.
- IRT members were chosen to provide
  - experience in long-term safety evaluations, including safety assessment methodology,
  - expert knowledge for each of the key components of the KBS3-method (e.g.: crystalline rock environment, waste form, copper canisters; bentonite clay buffer),
  - regulatory experience, and
  - competence in the societal aspects of repository development.
- IRT members were also selected to have a broad international composition and to provide a balance between specialist competence from academia and experts with broad knowledge of waste management and safety assessment.

# International Review Team (2)

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## Members of the International Review Team (IRT):

- **Sailer, Michael**, Chairman, Chemical Engineer, Öko-Institut (D)
- **Pescatore, Claudio**, NEA Convenor, Nuclear Engineer, (NEA)
- **Boissier, Fabrice**, Director of Risk Management Division, Andra (F)
- **Erning, Johann Wilhelm**, Material Scientist, BAM (D)
- **Kessler, John**, Nuclear Engineer, EPRI (US)
- **Kotra, Janet**, Chemist, NRC (US)
- **Löw, Simon**, Professor of Engineering Geology, ETH Zürich (CH)
- **Mayor, Juan Carlos**, Civil and Mining Engineer, ENRESA (Spain)
- **Stroes-Gascoyne, Simcha**, Civil Engineer, AECL (Canada)
- **Tokunaga, Tomochika**, Professor, Department of Environment Systems, University of Tokyo (Japan)

## Observer:

- **Compton, Keith** , Systems Performance Analyst, NRC (US)

# Working Base (1)

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- **Reviewed reports:**
  - SR Site (3 volumes, 2000 pages), the main report for the application (TR-11-01)
  - As needed: supporting documents by SKB (mainly published on internet); in total 64 reports
- **Working tools:**
  - Questionnaires to SKB (3 rounds)
  - Formal information meetings and formal hearings of IRT (May 17<sup>th</sup> to 19<sup>th</sup> 2011; December 12<sup>th</sup> to 16<sup>th</sup> 2011)
  - Visits of site / encapsulation plant / underground laboratory Äspö

## Working Base (2)

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- **Time budget of IRT:**
  - 1 person year (roughly one working month per IRT-member)
- **Interaction with SSM und SKB**
  - Documented contacts only
  - Only via SSM
  - All documents available for the public (only internal IRT documents excluded)
- **The report presents the consensus view of the IRT**

# Table of Contents of the IRT-Report (1)

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- **High-level findings**

including “Statement to the Swedish Government”

- **Main Report**

1. Introduction

2. Findings according to the remit of the review

3. Summary of findings, recommendations and conclusions in key technical areas

4. Detailed findings from the review of specific technical aspects

# Table of Contents of the IRT-Report (2)

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## Subchapters of Chapter 3 and 4 (of the main report)

- 1 Geosphere
- 2 Buffer and Backfill
- 3 Copper Canister
- 4 Fuel and cladding
- 5 Biosphere
- 6 Practical implementations
- 7 Performance assessment
- 8 Performance confirmation and Best Available Technique
- 9 Societal Aspects

# IRT's Statement to the Swedish Government (1)

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## **Question 1: “Is the SKB long-term safety case convincing at this stage?”**

- SKB generally gives a convincing illustration and technical basis both for the feasibility of the future repository, according to the KBS-3 design, and for its radiological long-term safety.
- The arguments presented are generally sound, based on current status of science and on par with the international state of the art.
- Nevertheless, in several areas improvements are possible, which would enhance confidence in the results of the safety analysis. Recommendations are provided in the body of the IRT report.

## IRT's Statement to the Swedish Government (2)

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### **Question 2: “Does SKB identify the major aspects that need to be developed in the future?”**

- SR Site and its supporting documents cover all major aspects that need to be developed in the future.
- Nevertheless within specific major aspects improvements are possible and are identified in the body of the IRT report.
- An important observation: The repository project is ready to leave the conceptual phase, which was mostly based on scientific research work. The industrial feasibility of the barriers and of the repository, including assurance of their quality, would now become increasingly important. More emphasis on these aspects is expected and will be necessary in the future.
- Another challenge for the future will be to both enhance and broaden the basis for the scientific evidence supporting long-term safety. To that effect, additional research and more detailed calculations will be needed for the safety cases supporting the next licensing steps.

## IRT's Statement to the Swedish Government (3)

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**The IRT also checked specifically whether there is anything “missing or amiss” in SR-Site**

- The IRT didn't find any major omissions.
- Some improvements regarding completeness at a lower level are identified in the IRT report.

# IRT's Statement to the Swedish Government (4)

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## **Presentation of safety arguments**

- SKB has presented its safety case for a repository clearly and in a well-structured manner, which generally allows the traceability and justification of its overall safety conclusions.
- The IRT has noted some areas where clarity and traceability of the safety case could be improved, and has provided recommendations to address those areas.

# IRT's Statement to the Swedish Government (5)

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## **Safety Assessment Methods**

- SKB safety assessment methods are generally on par with state-of-the-art, are sufficiently described, and SKB has presented credible scientific bases (FEPs [features, events, and processes], models, data, etc.) in support of their analyses.
- SKB's measures for quality assurance of the licensing documentation are generally sufficient at this stage of repository development.
- Recommendations have been provided to strengthen the discussion of quality assurance in the safety case and to improve the quality of the licensing documentation.

# IRT's Statement to the Swedish Government (6)

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## **Completeness**

- In the areas examined by the IRT, SKB has taken the current state of knowledge into account properly and nothing is missing or amiss at this stage of repository development.
- In some cases, the current state of knowledge is not yet complete because data from the actual subsurface excavation, which has not yet begun, are not available. The IRT expects that the completeness of SKB's safety case will be increased in future steps that address remaining technical issues.

# IRT's Statement to the Swedish Government (7)

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## Handling of remaining issues

- SKB has done a good job identifying remaining research and technical-development issues and has provided clear plans for their resolution.
- Recommendations: SKB should clarify the linkage between the safety analysis and the licensing, design, construction and commissioning processes, and further develop plans for a comprehensive programme of testing and monitoring to confirm its safety-related assumptions.

# IRT's Statement to the Swedish Government (8)

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## **Selection of site and disposal method**

- SKB's arguments in presenting KBS-3 as a robust disposal method that is well suited to meet all safety requirements are convincing and cogent. SKB approaches to public outreach in the site selection and method development process are at the forefront of international practice.
- Recommendations in the area of assuring continuing competence, knowledge management, and stakeholder involvement.

# IRT's Statement to the Swedish Government (9)

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## **Feasibility**

- At the present level of the stepwise licensing development, the technical implementation of the KBS-3 method is sufficiently described and credible to justify SKB's assumption on the properties of the repository system.
- Recommendations for SKB that would further increase confidence in SKB's assumptions on the feasibility of the initial state of the repository system.

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**Thank You Very Much!**