The International Peer Review under Aegis of the OECD/NEA, of SKB's Post-closure Safety Case for a Spent Fuel Repository in Sweden – 14641

Claudio Pescatore
OECD Nuclear Energy Agency (NEA), Paris, France.

ABSTRACT

At the request of the Swedish government the Nuclear Energy Agency (NEA) of the OECD organized an international peer review of the post-closure radiological safety case produced by the Swedish Nuclear Fuel and Waste Management Company (SKB) in support of the application for a general license to construct and operate a spent fuel geological repository in the municipality of Östhammar. The peer review was conducted over a period of about a year. The detailed findings of the independent peer review group were that 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. Many technical suggestions were also given on preparing for future steps in repository developments.

INTRODUCTION

A major activity of the Nuclear Energy Agency (NEA) of the OECD is the organization of independent, international peer reviews of national studies and projects in the field of radioactive waste management. At the request of the Swedish government the NEA organized an international peer review of the post-closure radiological safety case produced by the Swedish Nuclear Fuel and Waste Management Company (SKB) in support of the application for a general license to construct and operate a spent fuel geological repository in the municipality of Östhammar. The peer review took place between May 2011 and June 2012.

The NEA peer reviews help national programs to assess the work accomplished. The review reports may also be of interest to others with their comments on issues of general relevance. Since the KBS-3 concept is also adopted in Finland and in a similar geological setting, many of the peer review observations and conclusions may be applicable to the Finnish case as well.

OBJECTIVES AND ORGANIZATION

According to its Terms of Reference (ToR), the general purpose of the peer review was to help the Swedish government, 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 specific aim of the review was to provide the Swedish government with a statement, from an international perspective, on the sufficiency and credibility of SKB's post-closure radiological safety case for the licensing decision at hand. In developing such statement, the International Review Team (IRT) was asked to refer to international best practice in specific areas. Namely:

- Presentation of safety arguments,
- Safety assessment methods,
- Completeness,
- Handling of remaining issues,
- Selection of site and disposal method, and
- Feasibility.

In order to fulfil the ToR, the NEA established an IRT made up of 10 international specialists, including one member from the NEA. According to the ToR, the experts were chosen to be free of conflict of interest with SKB and to bring complementary expertise to the review. One additional expert was attached to the IRT as an international observer. The list of experts is reported in the Annex to this article. All contacts between SKB and IRT were organised and managed through the Swedish nuclear safety regulator (SSM).

The IRT met for the first time at a three-day orientation meeting in Stockholm in May 2011. During these three days, SSM presented its plans for the licensing review and applicable regulations. SKB staff gave a presentation on the license application with focus on post-closure safety. The IRT also discussed the ToR for the review, and the division of the work among the review team members. Within several months after the start of the review, the IRT sent three rounds of written questions to SKB. The questions included the standard set of questions developed for NEA-organised peer reviews [1] and questions specific to the current review. Secondary documents were reviewed as needed by the IRT. After SKB provided written answers to the IRT's questions, the IRT met for its 5-day main review meeting in Stockholm in December 2011. During this meeting the IRT conducted hearings of SKB staff and performed site visits to discuss outstanding questions identified by the IRT, summarised its preliminary review findings and planned for completing the review report. SSM staff and consultants participated in this meeting as observers, and the IRT gave a public, oral report to SSM on its impression of the review at the end of the meeting. The IRT was satisfied that it obtained all the information necessary to meet its peer review obligations. The final review report was released to the Swedish government at a public meeting in Stockholm in June 2012. In keeping with NEA procedures for independent reviews, neither the Swedish government nor SKB commented on the review report – SKB and SSM were given only an opportunity to check for factual correctness. The IRT made its best effort to ensure that all information was accurate and takes responsibility for any factual errors.

The final report [2] of the review presents the consensus view of the IRT. In accordance with the ToR, this consensus view is based on the experts' review of the main report of the SR-Site project [3], the report on site selection [4], the report on selection of method [5], and multiple supporting documents. All the relevant documentation is referenced in the final report of the review.[2] In addition, the experts relied on the information exchanged with SKB in answers to questions raised by the IRT, and on direct meetings with staff from SKB during the working seminars and site visits in Sweden.

The peer review conduct and results are fully documented on the public SSM web site under the rubrics "spent fuel repository – international peer review". In particular, the SSM web site provides videos of the Q&A sessions between the IRT and SKB, as well as videos of the various briefings to the Swedish stakeholders by the Chairman of the IRT, Michael Sailer of the Öko Institut, Germany.

MAIN FINDINGS

In the following, the findings of the IRT are reproduced verbatim for the most part.

On the licensing process in Sweden

The peer review documentation was submitted to the Swedish authorities in March 2011 as part of the application for a general license to construct and operate a spent fuel deep geological repository in the municipality of Östhammar. Once this general license is granted, additional licensing steps are necessary for the further construction and operation of the repository. For

these future licensing steps additional safety analysis reports have to be provided with more detailed technical argumentations and evidence. Taking this into account, and within the Swedish licensing and permitting context, SR-Site can be described as a preparatory Preliminary Safety Analysis Report. This stepwise approach to repository development and licensing is well-established international practice.

Overall Statement to the Swedish Government

The IRT report states that “From an international perspective, SKB’s post-closure radiological safety analysis report, SR-Site, is sufficient and credible for the licensing decision at hand. SKB’s spent fuel disposal program is a mature program - at the same time innovative and implementing best practice - capable in principle to fulfill the industrial and safety-related requirements that will be relevant for the next licensing steps....”

“The overall question that the IRT asked itself was: “Is the SKB long-term safety case convincing at this stage?” The detailed findings of the IRT show that 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.

A second important question was: “Does SKB identify the major aspects that need to be developed in the future?” The IRT finds that 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 is that, with the current licensing step, the repository project will leave the conceptual phase, which was mostly based on scientific research work. As a natural progression of the repository project, the industrial feasibility of the barriers and of the repository, including assurance of their quality, will 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.

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.”

The above statement rests on the following high-level findings that arise from the ToR and are substantiated in the main body of the IRT report.

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. However, the IRT noted some areas where clarity and traceability of the safety case could be improved, and provided recommendations to address those areas.

Safety Assessment Methods

The 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.

The SKB's measures for quality assurance of the licensing documentation are generally sufficient at this stage of repository development. The IRT has provided a recommendation to strengthen the discussion of quality assurance in the safety case and to improve the quality of the licensing documentation.

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 could be increased in future steps that address remaining technical issues.

Handling of Remaining Issues

SKB has done a good job of identifying remaining research and technical-development issues and has provided clear plans for their resolution.

The IRT recommended that SKB clarify the linkage between the safety analysis and the licensing, design, construction and commissioning processes, and further develop plans for a comprehensive program of testing and monitoring to confirm its safety-related assumptions.

Selection of Site and Disposal Method

SKB selected and developed its KBS-3 disposal method within the widely and internationally accepted geological deep disposal strategy for disposing of spent fuel. 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.

The IRT made observations in the area of BAT (best available technique), and recommendations in the area of assuring continuing competence, knowledge management, and stakeholder involvement.

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 Forsmark repository system.

The IRT provided recommendations for SKB that would further increase confidence in SKB's assumptions on the feasibility of the initial state of the repository system.

AN INTERESTING SPECIFICITY OF THIS REVIEW

The review report notes that “a modern safety case should include not only technical arguments supporting safety but should also pay attention to socio-political, organizational and management aspects that might affect the safety of a repository.”

The IRT welcomed SKB`s activities in accord with the announced action plan for knowledge preservation as it regards the continuity of knowledge to be essential to the realization of final disposal of radioactive waste. The IRT therefore recommended that SKB outline how it will assure that competent personnel, financial resources and knowledge about the facility are available until the repository is closed properly.

The IRT observed that knowledge must be preserved and transmitted to future generations about the repository’s history, its significance, its contents and the importance of keeping it secure from inadvertent intrusion that could breach its engineered and natural barrier system. The IRT recommended that SKB consider several mechanisms for knowledge preservation, including creation of reservoirs of knowledge, namely centres of interest of past activity at the repository, so that people can continue to understand and interpret the records and markers. In the same vein, SKB could consider creating cultural links – a sense of heritage – between the repository and the host community region.

The IRT also reviewed SKB’s approaches to public outreach for the site selection and for the method development process and found that they are at the forefront internationally, e.g., SKB’s attention to community involvement in the decision-making process around siting and running nuclear waste management facilities. The IRT recommended that SKB strive not only to maintain its excellent record of public involvement at the local level, but also to expand stakeholder awareness and engagement at the regional and national levels at all future stages of the project.

CONCLUSION

The overall finding of the review is that from an international perspective, SKB’s post-closure radiological safety analysis report, SR-Site, is sufficient and credible for the licensing decision at hand. According to the IRT, SKB’s spent fuel disposal program is a mature program - at the same time innovative and implementing best practice - capable in principle to fulfill the industrial and safety-related requirements that will be relevant for the next licensing steps. Many technical suggestions were also given on preparing for future steps in decision-making for repository developments.

The technical and societal peer review of SKB’s license application file is still on-going in Sweden. The NEA and the IRT were happy to provide a service to the Swedish government and the Swedish public by organizing an international peer review that constitutes an international reference that will contribute both to deepen the review by others and to prepare future steps better.

REFERENCES

1. OECD/NEA, “International Peer Reviews in the Field of Radioactive Waste Management. Questionnaire on Principles and Good Practice for Safety Cases”, *NEA/RWM/PEER(2011)1*, Paris, France (2011).
2. OECD/NEA, “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 (Final report)”, *NEA/RWM/PEER(2012)2*, Paris, France (2012).
3. Swedish Nuclear Fuel and Waste Management Co. (SKB), “Long-term safety for the final repository for spent nuclear fuel at Forsmark, Main report of the SR-Site project.” *SKB Technical Report TR-11-01*, *Volumes I,II and III*, Stockholm, Sweden (2011)
4. Swedish Nuclear Fuel and Waste Management Co. (SKB), “Site selection - siting of the final repository for spent nuclear fuel.” *SKB Report R-11-07*, Stockholm, Sweden (2011)
5. Swedish Nuclear Fuel and Waste Management Co. (SKB), ”Choice of method – evaluation of strategies and systems for disposal of spent nuclear fuel.” *SKB Technical Report P-10-47,* Stockholm, Sweden (2010)

ACKNOWLEDGEMENTS

The following members of the NEA international peer review team participated in the review in their personal specialist capacity: Michael Sailer, Chairman, Öko Institut, Germany; Claudio Pescatore, NEA Convenor, OECD/NEA, France; Fabrice Boissier, Andra, France; Johann Wilhelm Erning, BAM (Berlin), Germany; John Kessler, EPRI, USA; Janet Kotra, USNRC, USA; Simon Löw, ETH (Zurich), Switzerland; Juan Carlos Mayor, ENRESA, Spain; Simcha Stroes-Gascoyne, AECL, Canada; and Tomochika Tokunaga, Tokyo University, Japan. In addition, Keith Compton, USNRC, USA, participated as observer.

The OECD/NEA gratefully acknowledges the many organizations that made their experts available to carry out the peer review.