



U.S. Department of Energy
Office of Civilian Radioactive Waste Management



International Review Team (IRT) Safety Case Recommendations for the Yucca Mountain Total System Performance Assessment (TSPA) Supporting the Site Recommendation

Prepared for the NEA's Integration Group for the Safety Case (IGSC), **Topical Session on the Safety Case**, October 15, 2003, Paris, France

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Purpose of Presentation

- To disclose the IRT's recommendations on the safety case (pages 3 through 8)
- To summarize the IRT's recommendations (page 9)
- To show what impact the IRT's recommendations have on the DOE's work for the License Application (LA) (pages 10 through 12)
- To show that Nuclear Regulatory Commission (NRC) expectations of the DOE's LA, as defined in their Yucca Mountain Review Plan, are in line with IRT suggestions for the content of a safety case (pages 13 through 16)
- To suggest that the DOE is preparing the equivalent of a safety case, as suggested by the IRT, but in documents that fit the national situation and regulatory context (page 17)



IAEA/NEA International Review Team (IRT) Safety Case Recommendations

- **Mention of the safety case was made in several places in the IRT document: “An International Peer Review of the Yucca Mountain Project TSPA-SR: Total System Performance Assessment for the Site Recommendation (TSPA-SR).” OECD 2002.**
 - **Summary Section 2.2:** . . . a broader safety case should have been developed to support the site recommendation decision.
 - **Summary Section 3.1:** A Safety Case should be developed as a higher level document, and include the articulation of a strategy to achieve safety as distinct from the strategy for demonstrating compliance, with an emphasis on obtaining and communicating understanding and facilitating dialogue with the relevant stakeholders. A Safety Case is the integration of relevant arguments in support of the long-term safety of the repository. In particular, a statement of confidence should be included, to elucidate the means that were adopted to achieve sufficient confidence, and to acknowledge the remaining issues, together with a suggested strategy for resolving those issues. This should build upon the current Repository Safety Strategy document.



IRT Safety Case Recommendations (Cont'd)

- **“An International Peer Review of the Yucca Mountain Project TSPA-SR: Total System Performance Assessment for the Site Recommendation (TSPA-SR).” OECD 2002.**
 - **Summary Section 3.2:** In a future safety case it would be helpful to include a section in the main body of the report describing the evolution of the disposal concept. In addition to indicating how design changes have responded to safety concerns, this would provide continuity and would enhance confidence by demonstrating that the project is maturing and developing in a logical and systematic manner.
 - **Summary Section 3.4:** Nevertheless the TSPA-SR report has some shortcomings in terms of overall clarity and comprehensibility. This may be due to it being written for a number of different types of readers and is an area where improvement could be made. To address this problem in future, it would be appropriate to produce documents for different sets of stakeholders including a summary document where the whole YM concept, context and safety case is presented in a form suitable for a more general audience.



IRT Safety Case Recommendations (Cont'd)

- **“An International Peer Review of the Yucca Mountain Project TSPA-SR: Total System Performance Assessment for the Site Recommendation (TSPA-SR).” OECD 2002.**
 - **Section 2.2:** Alternative rationales for site suitability evaluation could also have been based around the development of a "safety case" Performance assessment is only one component of the safety case, other components being development of a strategy to achieve safety as distinct from the strategy for demonstrating compliance, with an emphasis on obtaining and communicating an understanding of the integrated system and its performance and favouring dialogue with the relevant stakeholders. . . . the existence of multiple barriers in the repository design and natural system is also a part of a safety case. . . . a safety case should include a statement of confidence . . . that acknowledges the existence of any unresolved issues and provides guidance for work to resolve these issues in future development stages it would have been preferable to have incorporated the TSPA within a safety case in support of the site recommendation decision



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IRT Safety Case Recommendations (Cont'd)

- **“An International Peer Review of the Yucca Mountain Project TSPA-SR: Total System Performance Assessment for the Site Recommendation (TSPA-SR).” OECD 2002.**
 - **Section 2.3:** A sixth step is also mentioned in the TSPA-SR report, namely the development of a repository safety strategy and the principal factors. This step is discussed within a separate Repository Safety Strategy (RSS) document . . . which is potentially the most important safety case report but whose status is somewhat unclear. This represents a move towards implementing the NEA Confidence Document . . . as discussed in [Section 2.2](#) above.
 - **Section 2.4:** *The IRT recommends that, at an appropriate point, the USDOE should produce a document of a few tens of pages where the whole YM concept, context, and safety case is presented in a form amenable to a more general audience. This should emphasise the expected performance of the repository up to and beyond the compliance period. A relevant example is the summary of the Canadian Environmental Impact Statement (AECL, 1994).*



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IRT Safety Case Recommendations (Cont'd)

- **“An International Peer Review of the Yucca Mountain Project TSPA-SR: Total System Performance Assessment for the Site Recommendation (TSPA-SR).” OECD 2002.**
 - **Section 3.1:** *The IRT recognises the need for a performance assessment to be well focused on a given design. However, the IRT recommends that a discussion of design improvements and their role in the safety strategy should be included in future safety case documentation. This would provide continuity and would enhance confidence by demonstrating that the project is maturing and developing in a logical and systematic manner.*
 - **Section 4.5:** *. . . the IRT recommends that if the Yucca Mountain project proceeds to the licensing stage, a safety case should be developed along the lines discussed in the NEA Confidence Document key messages from the NEA Confidence Document should be addressed in a safety case report for Yucca Mountain aimed at both the strategy to achieve safety and to demonstrate compliance. In particular, a statement of confidence should be produced, information contained in the RSS should be updated and extended, and used as a basis for developing the proposed safety case document for the next phase of the programme.*



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IRT Safety Case Recommendations (Cont'd)

- **“An International Peer Review of the Yucca Mountain Project TSPA-SR: Total System Performance Assessment for the Site Recommendation (TSPA-SR).” OECD 2002.**
 - **Section 4.6:** *The IRT recommends that a safety case produced in support of licensing should incorporate an improved demonstration of system understanding to counterbalance the present emphasis on uncertainty.*
 - **Section 5.1.2:** *. . . a broader safety case should have been developed to support the site recommendation decision.*
 - **Section 5.3.2:** *A safety case report should be developed along the lines discussed in the NEA confidence document.*



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Implications of IRT Safety Case Recommendations

- **Separate safety cases can be written, and should be written, to address the capabilities and interests of different audiences**
- **A submittal that is part of a licensing process, written for experts, should address system understanding as well as compliance**
- **A safety case, at any level of technical sophistication, should contain descriptions and evidence of:**
 - ◆ “science and good engineering practice”
 - ◆ “detailed and rigorous modelling of the disposal system”
 - ◆ “semi-quantitative and qualitative arguments”
 - ◆ *“a statement of confidence. . . an elucidation of the means that were adopted to reach sufficient confidence”*
 - ◆ *“acknowledgement of the remaining issues, and the suggested strategy for resolving the remaining issues”*



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Impacts of Key IRT Safety Case Recommendations

- In Section 2.4
 - *“The IRT recommends that, at an appropriate point, the USDOE should produce a document of a few tens of pages where the whole YM concept, context, and safety case is presented in a form amenable to a more general audience. . . .”*
- Products prepared and in progress:
 - A brochure was prepared by the Secretary of Energy’s office to inform the public about the Yucca Mountain site approval decision, it discussed the safety functions of the proposed system. It is available on the Internet at: <http://www.ocrwm.doe.gov/ymp/sr/faq.pdf>
 - The Environmental Impact Statement prepared to accompany the siting decision has a Summary with several pages explaining the site, transportation, the engineered system, and short and long-term safety implications: http://www.ocrwm.doe.gov/documents/feis_a/rgd_summ/rgsum_bm.pdf
 - A “Yucca Mountain Story” document is in preparation for the broader scientific/educated lay reader audiences (being written at a “Scientific American” level)



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Impacts of Key IRT Safety Case Recommendations (Cont'd)

- In Section 4.5 of the IRT report on TSPA-SR:
 - ***“The IRT recommends that key messages from the NEA Confidence Document should be addressed in a safety case report for Yucca Mountain aimed at both the strategy to achieve safety and to demonstrate compliance. In particular, a statement of confidence should be produced, which is an elucidation of the means that were adopted to reach sufficient confidence in the current analyses, an acknowledgement of the remaining issues, and the suggested strategy for resolving the remaining issues in support of the next decision.”***
- TSPA-LA documents now in preparation:
 - ◆ Explicitly recognize the advice given by the IRT
 - ◆ Explicitly address confidence (in validation section)
 - ◆ Recognize that TSPA is part of a larger safety argument or case which addresses remaining issues and data needs for their resolution



DOE's 2002 TSPA-LA Methods and Approach Document

- In Section 1.1 explicit mention is made of the NEA/IAEA review as an external review that will be taken into account as TSPA-LA continues to be developed.
- In Section 7, on TSPA model 'validation,' the words 'confidence' and 'confidence-building activities' appear in association with several of the techniques specified under the general heading of 'validation'
- The NEA/IAEA review is cited, with the suggestion that a model that includes some of the enhancements suggested by that review for this next phase of TSPA, should increase confidence in the TSPA-LA model



The Safety Case for the License Application

- **The License Application is a product being written by implementing organization specialists for regulatory organization specialists**
- **The regulator, the US Nuclear Regulatory Commission, has written detailed guidance, stipulating its review criteria (Yucca Mountain Review Plan, NUREG 1804, Rev. 2, 2003)**
- **The words “safety case” only occur in reference to a DOE usage of the words, but document headings and content make it clear that what is expected is the near equivalent of a safety case**



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Postclosure Safety Demonstration to Include Plans for Ongoing Science Work

- **The NRC’s Yucca Mountain Review Plan requires a comprehensive statement demonstrating postclosure safety in its Section 2.2 Repository Safety After Permanent Closure**
- **It requires the identification of remaining safety questions and how they will be addressed in its Section 2.3 Research and Development Program to Resolve Safety Questions**
- **Its Section 2.4 Performance Confirmation Program requires the plan for monitoring key aspects of the system over time to assure data and assumptions remain valid**



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Other Safety Case Aspects Expected in the TSPA-LA: Basis, Context, Uncertainty

- The TSPA-LA is to be evaluated as described in Section 2.2.1 of NRC's Yucca Mountain Review Plan, e.g.:
 - ♦ “the technical support for models and parameters . . . based on detailed process models, laboratory and field experiments, and natural analogs”
 - ♦ “the barriers important to waste isolation” in terms of their “importance,” and their “capability” and its “technical basis”
 - ♦ “identification and classification, screening, and construction of scenarios from the features, events, and processes considered”
 - ♦ “parameter ranges and distributions, . . . representation of spatial and temporal scales, and whether the performance assessment model appropriately implements the abstracted model” including “the relevant data, the corresponding uncertainty, and effects on the performance of the repository”



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Confidence Is A Requirement for the License Application Safety Analysis

- **The NRC's Yucca Mountain Review Plan mentions “confidence” several times in its section 2.2.1.4: “Demonstration of Compliance with the Postclosure Public Health and Environmental Standards”**
- **Confidence is mentioned under a statement of a criterion entitled: “The Total System Performance Assessment Code Provides a Credible Representation of Repository Performance.”**
- **The requirement is for there to be “confidence that the code is modeling the physical processes in the repository system in the manner that was intended.”**



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Conclusion: The DOE is Providing the Equivalent of a Safety Case

- **NEA/IAEA IRT recommendations on the safety case are being implemented**
 - The NRC's statement on what will be looked for in the review of the postclosure Safety Analysis Report, which will contain the TSPA-LA, show it to be expecting the equivalent of a safety case
 - The 2002 Final Environmental Impact Statement for a Yucca Mountain repository contains analyses that go beyond the times and distances required for a compliance demonstration, to provide additional understanding
 - A plain language brochure explaining the Yucca Mountain site approval decision in 2002 contained elements of a safety case for the general public

