Session VI
Safety Demonstration

Presentation 1: The structure, content and use of safety cases in demonstrating the safety of radioactive waste disposal facilities

F Besnus IRSN

Summary

In terms of the IAEA, the Safety case is an intergration of arguments and evidences that describe, quantify and substantiate the safety, and the level of confidence in the safety of a (geological) facility.

The outcomes of the safety case are:

- It should take place in a step-by-step manner with well-defined decision points.
- Regulatory and licensing authorities and their technical support organisations must be informed about the state of development at each step and involved in the major decisions (e.g. about the disposal facility concept or about R&D priorities), no matter whether or not there is a formal requirement for doing so.

From a regulatory perspective, the key stages are:

- conceptualisation,
- siting,
- design,
- excavation/construction,
- operation,
- closure.

The following aspects should be considered at each of key stage :

- Facility design and the safety strategy
- Demonstration of site and engineering suitability :
- Impact assessment
- Adequacy of management systems

Conclusions:

- Structure of safety case should be maintained through every stage of the step-by-step process, with the content of the safety case being progressively developed as the project proceeds. For each key step of decision making, a decision should be taken only if structured information on all important elements of the disposal system is available
- Whatever the stage is the Safety case must back up on a Safety assessment that always comprises three components:

- The assessment of the engineering
- The assessment of the impact
- The assessment of the management system

Issues

- What is the relative importance of the engineering safety assessment

Presentation 2; 2007 Vaalputs PCRSA: Confidence in the long term safety assessment of Vaalputs
Japie van Blerk, RSA

Summary:
The post closure safety assessment for the South African shallow land repository was performed because new regulations were promulgated and to expand the source term for the facility. The source term was revised to include power reactor waste, historic waste from the fuel cycle, and future waste from the pebble bed modular reactor.

The assessment was performed in the context of

- Consistent with ICRP standards and recommendations
- Target audience being the regulator and waste generators
- Operational period of 50 years
- Institutional control period of 300 years
- Considered 10,000 years as the period of regulatory concern

The 4 natural exposure and two human intrusion scenarios

- Nominal Scenario
  - Judged to be a reasonable future behaviour of the facility
- Late Subsidence Scenario
  - Represent the uncertainty about the degradation of waste container and materials in the LLW trenches
- Climate Change Scenario
- Seismic Scenario
- Drilling Intruder Scenario
  - Assess the exposure of a driller to borehole cuttings brought to the surface during a drilling intrusion event
- Post-Intrusion Resident Scenario
  - Farmer builds a house on top of the disposal trenches, receive exposure from the borehole cuttings, and uses the borehole for farming purposes

Compartmental modelling approach

- Amber (Necsa assessment)
- Ecolego (Supporting assessment)
- Near field was compartmentalised according to 5 waste types
- Contribution of certain compartments was excluded
    - Grounds of uncertainty (e.g. the saturated zone)
    - Indications that the nominal fractions of activity accumulating in a compartment would be limited (e.g. upward pathway due to evapotranspiration)
    - Scenarios considered were: natural exposure scenario, driller scenario, post intrusion scenario,

Assessment results:

- Natural exposure scenarios
    - Peak dose at 10,000 years: below 10-2 mSv/y
        - Below 10-1 mSv/y at all times
    - Dominant nuclides
        - I-129, Tc-99 and Np-237
    - Dominant pathway
        - Water consumption
        - Egg/mutton consumption
    - Probabilistic analysis
        - Deterministic analyses represent 95th percentile of uncertainty range

Conclusions:

- Given the assessment results and the conservative nature of the assessment, the assessment concluded that most new data collection activities (with a few key exceptions) would be expected to lead to improved system performance

- The assessment concluded that the likelihood is high for post-closure safety at Vaalputs to be demonstrated successfully for the disposal of a national inventory of LILW

- It was concluded that, given the assumptions and conditions imbedded in the assessment, the use of near surface disposal trenches is effective and sufficient for the disposal of the national inventory of LILW

- How is the strategy for the safety assessment influenced by factors such as chemical characteristics of the waste and the radiological end point when the facility is removed from regulatory control?

Presentation 3: International inter-comparison and harmonization
Phil; Metcalf, IAEA

- In the process of harmonization, what does the IAEA do to ensure participation of the operator, the regulator and the interested and affected parties?

Summary of paper:
The safety fundamentals are:

- Responsibility for safety
- Role of government
- Leadership and management for safety
- Justification of facilities and activities
- Optimization of protection
- Limitation of risks to individuals
- Protection of present and future generations
- Prevention of accidents
- Emergency preparedness and response
- Protective actions to reduce existing or unregulated radiation risks

Leadership and management of safety:

- Safety has to be assessed for all facilities and activities, consistent with a graded approach.
- Safety assessment involves the systematic analysis of normal operation and its effects, of the ways in which failures might occur and of the consequences of such failures.
- Safety assessments cover the safety measures necessary to control the hazard, and the design and engineered safety features are assessed to demonstrate that they fulfil the safety functions required of them.
- A facility may only be constructed and commissioned or an activity may only be commenced once it has been demonstrated to the satisfaction of the regulatory body that the proposed safety measures are adequate.

Examples of IAEA initiatives with regards to inter comparisons and efforts to harmonies the approaches:

- **ASAM** Application of safety assessment methodology–near surface repositories, 2002 - ongoing
- **SADRWMS** Safety Assessment Driving Radioactive Waste Management Solutions, 2004-ongoing
- **DeSa** Evaluation and Demonstration of Safety of Decommissioning of Nuclear Facilities, 2004 -ongoing
- **EMRAS** Environmental Modelling for Radiation Safety, 2003 – ongoing
- **GEOSAF** Safety of Geological Disposal, 2007 – ongoing
- **Mining Waste**
    - Uranium - 2007

- Phosphate – 2007

It can be concluded from the harmonisation processes that the following common issues where identified:

- At each step, it is necessary to revisit the following aspects of the safety assessment supporting the safety case and to consideration their integration:
  - That related to assessment and demonstration of the site and engineering suitability
  - That related to radiological impact assessment
  - That related to demonstrating the adequacy of management systems

Presentation 4: Regulatory Romania
Vilmos Zsombori, Romania

The regulatory framework as applied in the country was presented. Authorization follows a phased approach which includes predisposal, disposal storage and decommissioning. The presentation explained the different existing facilities in the country and their functions. Currently a disposal facility is situated at Baita Bihor, which was designed to handle low and intermediate waste. A new repository is planned at Saligny.

The VVR-S research reactor at Magurele is planned for decommissioning. Currently fuel is stored in pool on site. However the fuel is planed to be returned to Russia.

The Triga research reactor is to be decommissioned and the HEU to be sent back to USA.

The zero power reactor at Pitesti is to be decommissioned.

The spent fuel from the nuclear power plant will be stored on site at Cernavoda. The licensing process follows a phased approach.

In conclusion:

- There is new built planned for the nuclear power programme.
- Currently the waste management facilities have limited capacity and does not make provision for spent fuel
- Spent fuel is sent back to the country of origin.
- A spent fuel facility is being built on site at the operating plant at Cernavoda.

- What factors were taken into consideration during the design of your Saligny waste storage facility and what will happen to the old facility at Baita Bihor.

Presentation 5: Radioactive waste safety management in China
Zhaorong Shang, China

The presentation focused on the following areas

- Chinese regulatory authority
- Radioactive waste generation
- The national regulations framework
- Radioactive waste safety management principle
- The waste classification
- Regulatory system
- Requirements for radiation protection
- Challenges

The regulatory framework makes provision for various aspects regarding waste management such as basic safety standards, predisposal management, discharges, disposal, and decommissioning.

Disposal options that could be considered include near surface disposal, surface disposal, geological disposal, disused sources and exempt discharge. A detailed waste classification exists. The regulatory system for obtaining a nuclear authorization and the processes of verifying compliance were discussed.

China signed some international conventions such as “Convention on the Physical Protection of Nuclear Materials”, “Convention on Nuclear Safety”, and “Joint Convention on the Safety of Spent Fuel and on the Safety of Radioactive Waste Management”

The following radiation protection principles apply:

- To adopt justification, optimization and dose limits.
- To apply ALARA principle effectively to make an
- assessment to the radiation workers and public.
- The basic dose limit for an occupational worker is
- 50 mSv/a, and for the public is 1 mSv/a.
- SEPA requests the utility to make a conservative management dose limit, 0.25 mSv/a for the public, taking account of overall exposure from other sources.
- The annual dose limit to the public for exemption waste is 0.01 mSv/a.

The Chinese nuclear industry faces the following challenges:

- regulatory independence from politics?
- regulations and implementation?
- public education on RW?
- how to regulate NORMs?
- where the classification boundary line?
- disposal methodology for disused sealed source?

In conclusion, the Chinese nuclear industry is well established and has regulatory processes for most activities regarding waste management in place. However they are still facing issues such as NORM, disused sealed sources, lack of understanding by the public and the politicians

- What is important to be considered when new regulations must be promulgated for nuclear activities, such as the geological repository and how would these be implemented?

SAFRAN tool
Wolfgang Goldammer

The SAFRAN tool was developed by several scientists on request of the IAEA. Initially the tool was developed for application in situations of operational and emergency waste management. A new version is being developed for applications in decommissioning. The tool is not intended to replace a full scale safety assessment but can be handy to collect all information in a ordered manner. It is freely available on the IAEA website and participants are encouraged to use the tool. Comments on shortcomings should be sent to the compilers who would improve the tool to make it more useful for future applications.

In very limited time the application of the tool from the input of source terms and scenarios for various facilities was demonstrated. It was explained that the tool performs calculations required in various situations and it also has a reporting function. It could also be used in decision making.

- Will there be documentation available, which explains the parameters and algorithms used in the tool if modifications may be required?
- How and when will this tool be made available and will there be training provided for the use of the tool?

PANEL DISCUSSION

1 Engineering assessment

During the panel discussion the relative importance of engineering assessment and the place of the engineering assessment in the whole control process was debated. It was concluded that much emphasis is placed on radiological safety. Engineering assessment forms the basis of any safety assessment but it can not stand on its own. The engineering assessment should be complemented by radiological safety assessment and control programmes. The basic principles of optimization, justification and dose limits should be demonstrated in the process of the safety assessment.

2 The Vaalputs safety assessment was performed from 2036 and institutional control will apply for a further period of 300 years.

Summary of the session

The session started of with a presentation on a framework for the safety case. This was followed by an example of a long-term safety assessment for a shallow land repository at Vaalputs in South Africa. The middle presentation on inter-comparisons on an international level by the IAEA in order to harmonize the safety assessment approach, was the summary of the session. The conclusion of this session was that the safety assessment is a step-by-step process, required to support the safety arguments in an integrated manner. It should emphasise the site and engineering suitability, give orders of magnitude of the possible radiological impact and demonstrate that an adequate management system is implemented.

This presentation was followed by two presentations on the regulatory approaches in Romania and in China respectively. The morning session was concluded with a short introduction to and demonstration of the SAFRAN tool developed by the IAEA for use by member states in waste management.

Session VII

The concept of a Common Framework

Presentation 1: Common framework: Waste types, disposal options and the linkage

Luc Baekelandt, Belgium

Presentation on a Common framework

This presentation laid out a proposal for a common framework for the safe management and disposal of radioactive waste. The recognized safety objectives and safety principles were laid out and, in this context, proposed matrices were presented for generic waste types, disposal types, generic linkages and NORM waste.

PANEL DISCUSSION

- The panel discussion touched on the issues of Pros and cons of prescriptive vs. a performance based approach. It was generally agreed that the performance based approach provides greater flexibility and a better opportunity to achieve an optimized solution. However, it was also pointed out that it requires a mature regulator and that it may not be suitable for all licensees. Small licensees would likely not have the resources for a propose-dispose approach.
- It was recognized that setting radiological criteria for the long term would be difficult. Various options were discussed and it was pointed out that the most robust solution may also end up being the least costly. Also, there may be safety benefits in carrying out the work right away.
- Since the common framework is also a common approach to safety, it is expected that its implementation would lead to better stakeholder acceptance. Again, countries could integrate the guidance in their own documents.
- While it is hard to quantify an acceptable a tradeoff between economy and safety, the most expensive option may turn out to be the cheapest.
- It was felt that the existing proposal would accommodate mixed waste.
- The common framework links management options and classification. Implementation would require programmatic and management tools in addition to regulations.
- Equivalencies in the proposal for NORM may require some revision as they are not truly equivalent and the two classification schemes should agree on NORM definitions.
- Tailings pose unique problems due to their volume and long term hazard and other solutions may be required to deal with local conditions and effects.
- The participant touched on the subject of how safe is safe
- why propose near surface when sooner or later will need a DGR? (depends on situation)
- It was clarified that the proposal is an IAEA recommendation, which may be published as a separate document. There is no link to the Joint Convention.

SUMMARY OF THE SESSION

This session discussed the application and practical benefits of a common framework for the management and disposal or radioactive waste. There was agreement among the participants that there are common safety, technical, economical and societal aspects that need to be addressed and these could be best handled through a common approach. However, it is important to realize that a proper classification scheme is required to support any such approach.

In conclusion, a common framework will help to find a safe and cost effective disposal solution for the various wastes and will assist in decision making to link a waste type with a suitable disposal option.

There was widespread support for the issuance of such a reference document by the IAEA. While countries that have developed policies for the management and disposal of nuclear waster could use the document to provide background for their policies, other countries could use the document for policy purposes.