Closure Session

Friday, 25 November 2016
Vienna, Austria
Board Room A (M1)

Conclusions from the International Conference on the Safety of Radioactive Waste Management
This conference was the first comprehensive conference on the safety of radioactive waste management organised by the IAEA since the 2000 conference on the same topic, held in Córdoba, Spain. It gave the 276 registered participants from 63 countries and four international bodies an opportunity to take stock of progress since the previous event, discuss questions that are still open, and identify new issues that require resolution. A total of 45 oral presentations and 80 posters were presented within four topical areas, followed by topical discussions and broader plenary discussions. The topics were:

- National policy, strategy and framework for radioactive waste management.
- Predisposal.
- Disposal.
- Post-accident waste management.

The list of conclusions below has been prepared by the Conference Chair in consultation with all Session Chairs. A draft was discussed at the closing plenary of the Conference, and the eight high-level conclusions from the Conference were subsequently finalised as per below.

1. **Progress in radioactive waste management since 2000**

The Conference noted that since the 2000 Conference in Córdoba, there has been significant progress in radioactive waste management. While national approaches differ, waste safety has improved across the board, including initiation (and in many cases completion) of clean-up operations dealing with legacies in different parts of the world, and also with regard to the establishment of facilities for storage and disposal of radioactive waste. The *safety case* approach to demonstrating safety has taken a great leap forward and is well established as a best-practice approach, supported by a suite of safety standards that has been developed in recent years. Five review meetings have been held under the terms of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (JC) which entered into force in 2001, and the number of Contracting Parties to the JC has steadily increased.

However, notwithstanding significant progress in some countries, establishment of facilities for HLW/SF disposal is progressing slowly, which sometimes (in the broader community but also in the waste management community) is perceived as lack of success. This is, however, not a justified conclusion since, in the intervening time, our understanding of long-term safety has improved and our previous conclusions on safety over long terms have been corroborated by new studies. We have also come to the realisation that the establishment of such facilities *does* take a very long time, and that we should allow it to take as long as required while still maintaining the path forward. Overly optimistic timeframes may equate to setting oneself up to fail. We should also bear in mind that the time that is required to establish a HLW/SF disposal facility is very short in relation to the time the material remains hazardous and (safely) disposed of.
**Suggestion**: To better convey the positive message that the process of HLW/SF disposal is slow because it is meticulously analysed in all its technical detail, and subject to scrutiny through intense engagement with and of stakeholders. In addition, convey that the stepwise licensing process and refinement of the safety case drives best possible understanding of safety, in a transparent manner. This is notwithstanding the significant challenge to address societal factors and social acceptance which will continue to require strenuous ongoing efforts.

2. **National planning**

The definition of endpoints (for waste management) and end states (for remediation) needs attention and decision, as this will determine for example, waste streams, timing and costs, and promote the development of integrated national plans for radioactive waste management that take into account safety, security, safeguards and protection of people and the environment; as well as provide certainty to stakeholders and the general public. This includes decommissioning of major sites and re-characterisation of waste followed by treatment and reconditioning. The classification system used in the safety standards promotes characterisation of waste streams in a manner that is coupled to the disposal solution. However, this is not without its challenges; e.g. in many countries also small amounts of long lived waste, especially radon-producing waste from NORM materials, is present in very low/low level waste, which requires special consideration in the final stages of management including disposal. The planning also needs to consider human resources as well as knowledge management and transfer, in view of the long lead times of many disposal and remediation projects.

Storage is a recognised and necessary interim measure and can be done safely over extended periods of time if effectively managed through ageing management, knowledge management, and other activities. However, disposal remains the recognised endpoint. The planning can include a more proactive consideration of regional/multinational facilities, where little concrete action has been taken so far.

**Suggestion**: That the work on national plans for radioactive waste management including disposal continues, taking a cradle-to-grave approach, and be accelerated as necessary. This can, as appropriate, include consideration of an entirely national plan as well as an alternative path to disposal which involves shared facilities, either on a bilateral, regional or multinational scale. The plan should also clearly outline approaches to classification (e.g. with regard to waste of mixed characteristics), and define concepts like *reversibility* (of plans) and *retrievability* (of waste) and their application.

3. **The balance between operational and long-term (post-closure) safety**

Depending on national context and timing of the radioactive waste management programme, attention may at times have drifted away from operational safety while efforts were focused on developing geological disposal facilities, including analysis and demonstration of their safety. Over the 16 years that have passed since the Córdoba Conference, a number of events have occurred that may justify increased attention to operational safety including safety
culture. Many of them have been discussed in great detail at regular waste management conferences; however, a comprehensive analysis may now be timely and appropriate.

**Suggestion:** To carefully analyse the post-2000 experience of the operational safety of radioactive waste management, and take stock of that experience for the purpose of developing further international guidance that may support and strengthen the safety case in national programmes. Feedback from events can be strengthened, and the fundamental importance of promotion and improvement of safety culture should be continually emphasised.

4. **Optimisation**

Optimisation is the foundation of the radiation protection system. While recognised by all countries as being applicable to all activities related to radioactive waste, this principle is not always consistently implemented, especially with regard to analysis of waste management options. The discussions during the Conference highlighted that optimisation could not rely only on comparison of dose estimates, considering the uncertainties inherent in long term dose assessments, although including dose assessments in comparison of design options should be encouraged. It was pointed out that the demonstration of optimisation should be understood in a broader sense, based on a process that enables comparing strategies that encompass different possible options for all steps of waste management, and should consider the impacts of all choices made while deciding on a strategy.

**Suggestion:** To continue and as necessary initiate work on the methodologies that may support the optimisation of strategies for waste management, with due consideration to all impacts, whether of radiological, ‘conventional’ or socio-economic nature.

5. **Results of analyses, and communication, of long term protective capability of disposal solutions**

A further number of safety assessments aimed at estimating radiation exposures into the far future have been performed since the Córdoba Conference in 2000, with the aim of demonstrating compliance with regulatory criteria and as a guide to optimisation of protection. Methodologies have matured and are yielding consistent results with exposure levels for normal evolution scenarios generally falling within the range from <10 to a few tens of micro Sv annual effective dose, and with higher estimates (but generally below 1 mSv) for less likely scenarios. The criteria in terms of ‘constraints’ or ‘targets’ are variable, but the assessments consistently meet the criteria. However, the analysis should appropriately consider uncertainties in support of the decision making process. There appears to be broad consensus on the applicability and relevance of probabilistic vs deterministic (e.g. intrusion) analysis, depending on scenario.

**Suggestion:** That the outcome of such analyses, which generally provides a level of confidence and assurance of safety, is articulated in a way that facilitates communication and engagement with stakeholders on complex issues such as acceptability (of activities and
facilities), optimisation, inferred health risks for future generations and the environment, and the ethical foundation for cradle-to-grave radioactive waste management.

6. Regulators’ involvement, mandate and independence

The heightened interest in advancing programmes for radioactive waste management including disposal, some of them triggered by the 2011 nuclear accident in Japan, has in some countries led to the establishment of a variety of national ‘bodies’ with advisory or executive functions, as well as increased engagement from the political level; this shall not impede on the independence and integrity of the regulatory function. In addition, it is now widely recognised that the regulator has to be a visible party that is actively engaging with stakeholders from the outset; this provides clarity, promotes trust and mitigates the risk for surprises. This is particularly important for disposal projects, where the lead time is long and involves successive licensing decisions. Each of these licensing decisions will have to be taken under some level of uncertainty as the safety case for the disposal concept is still evolving through the early stages. Regulator visibility and engagement helps building confidence in the decision-making process under such circumstances.

**Suggestion:** That regulators develop processes to ensure mutual understanding between regulators and applicant, while rigorously maintaining their independence, drawing on the Fundamental Safety Principles and on the Safety Requirements outlined in GSR Part 1. Regulators should continue to collaborate internationally on regulatory matters, including a consistent approach to licensing of initial steps of the establishment of a disposal facility while uncertainties remain around its final performance, and in the licensing approach to shared (between countries) facilities, should plans for the establishment of such facilities go ahead.

7. Involvement and empowerment of interested parties

The need for a genuine and honest engagement with stakeholders has long been recognised. The major development since 2000 is in the quality and approach to this engagement. This includes the recognition of the importance of the early involvement of the regulator, and the means for taking stock of the knowledge, and to respect the values, of populations in areas that have been identified as suitable for siting of waste facilities. This results in empowerment of those populations and gives them a ‘voice’ with regard to local and/or traditional life-style, and societal and environmental factors specific to the area, which will have to be considered in the environmental impact assessment. It is equally important to establish a common understanding of consequences should no action with regard to radioactive waste management including disposal be taken, and to agree on mechanisms to settle disagreements.

**Suggestion:** Principles and methods for engagement can be further developed and implemented as they apply to national programmes, and harmonised in the case that regional or multinational disposal solutions are considered.

8. Post-accident waste management
The Conference discussed the challenges that for many years to come will face radioactive waste management in the aftermath of the 1986 and 2011 nuclear accidents in the Former Soviet Union and in Japan, respectively. While these are significant examples, there are several others where post-accident remedial work is necessary. A common denominator for all such projects is that the waste is ‘unusual’ in terms of mix of radionuclides, waste matrix, chemical composition, volume and other characteristics. The current system for radioactive waste management is not well suited to support waste management following an accident. While optimisation of waste management remains relevant, dose criteria that are applied under these circumstances are based on the understanding that these are existing exposure situations; criteria normally applied for planned exposure situations are not applicable, very difficult to apply and generally not justified. Some countries are investigating options for post-accident waste management, taking the view that generic planning for post-accident recovery should be performed before any accident, in order to promote clarity of roles, criteria for remediation, technical approaches, disposal options for accident waste and communications should an accident happen.

**Suggestion**: There is now ample experience from dealing with post-accident radioactive waste management, ranging from small-scale operations to major operations that may be going on for a century. The suitability of the safety standards to deal with post-accident radioactive waste management should be reviewed against this backdrop and plans for providing additional guidance on developing national strategies for post-accident recovery should be developed for Member States’ consideration.

Looking ahead, it might within a suitable timeframe (but less than 16 years) be useful to convene an international meeting to follow up on this Conference, to monitor progress in the areas where further work has been suggested based on the Conclusions listed above. This may also give an opportunity to discuss experiences from the establishment of facilities for disposal of HLW/SF. A broadening of the perspective could be considered, including involving waste generators and discussing NORM management, to foster a discussion of optimisation and integration of all areas of waste management, cradle-to-grave.