

## **President's conclusions**

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Dear Friends, I think we have had a productive conference this week on a very important subject “the management of spent fuel from nuclear power reactors”; a subject that is linked with the role of nuclear power in meeting global energy needs in a sustainable and climate friendly way. I have carefully listened to most of the presentations and the discussion that followed and I have also the benefit of inputs from the session chairmen and colleagues from the IAEA. It is always a challenge to condense a week of deliberations into a short conclusion. This is what I am attempting for you.

At the present time most of spent nuclear fuel in the world is stored in reactor pools and in interim storages. Although it is safe and secure, as the evidence from this conference confirms, it has to be recognized that such storage represents only an interim stage in any spent fuel management strategy. While in countries like France, Russia, Japan, India and others there are ongoing programmes to recycle spent fuel, there is an urgent need to move on towards final disposal options. The delay has been caused, for the most part, by the slow rate of development of geological repositories for final disposal of spent fuel. Fortunately, as we heard in presentations, there is good news on this front – the geological repository projects in Finland, Sweden and France are moving towards the licensing stage.

It will still be several decades before repositories are available in all of the major nuclear countries. For these reasons, it is becoming clear that spent fuel will have to be stored for longer periods than initially intended. Storage times may have to be extended up to 100 years and beyond. Questions then arise about the safety, security and sustainability of storage over such long time periods. In order to demonstrate safety over these time periods a good understanding of the processes that might cause deterioration of the systems is needed. This conference has shown that these new priorities are reasonably well understood and studies have been presented here aimed at investigating the various phenomena that might cause the failure of storage systems over long time periods. The issue is also being increasingly recognized by regulators and we have heard about the sort of proofs that they would be looking for in licensing storage facilities over extended periods of time.

More than 60 ‘newcomer’ countries have indicated that they are interested in developing nuclear power in their countries. Many of them have turned to the IAEA to obtain information on the implications and the infrastructures that would be required. While their initial attention tends to be on the legal, regulatory, educational and industrial infrastructures needed to start nuclear programmes, they also need to develop strategies for spent fuel management. Information about reactor systems and fuel supplies is readily available from vendors but it has proved to be more difficult for newcomers to obtain reliable information about the solutions that are required to be put into place in respect of the back-end of the fuel cycle. It would be unrealistic to expect the vendors to provide a guarantee that all back-end aspects would be provided, e.g., spent fuel reprocessing, storage and disposal. The IAEA should thus provide newcomer countries with all necessary information related to spent fuel management aspects including the long term issues so that they become intelligent buyers and no loose ends are left in terms of spent fuel management over the entire life cycle of the spent fuel.

In this context it is interesting to note that countries in which there are well established nuclear programmes seem to be learning lessons from the past. As part of the design approval process for planned new reactors in the UK, proponents are being required by the regulators to describe plans for decommissioning and radioactive waste management at the outset and, amongst other things, they are

being required to explain how spent fuel can be stored, recovered and transported for periods in excess of 100 years and how such facility lifetime can be sustained.

Multilateral solutions for storage, reprocessing and disposal in which there are sharing mechanisms between countries would greatly help smaller countries with small amounts of spent fuel and waste, limited resources, and, sometimes, small land areas. However, while these are being actively discussed in various fora (some under the auspices of the IAEA), none have yet materialized.

Taking into account the evidence from around the world, it appears that spent fuel is being managed safely. It was recognized, however, that standards should be continuously reviewed to reflect new knowledge and experience gained. Some areas were identified where more guidance could usefully be developed, for example, in relation to extended long-term storage and there was a suggestion that there could be greater harmonization in certain areas, such as international requirements for dry cask design.

There is a growing awareness that the storage and transport of spent fuel are linked because each stage in spent fuel management, whether it is related to open or closed fuel cycles, involves transport. Casks were initially considered for transport only. The 'dual purpose' cask is now a well-established technology for storage. To address the interface issues between storage and transport, a holistic approach to regulation is needed in which the different timescales for transport and storage licensing are accommodated.

One focus of the conference was on understanding the degradation phenomena that might affect the storage of spent fuel over long time periods. Important potential material degradation mechanisms are: air oxidation, stress corrosion cracking, thermal creep, hydride reorientation and delayed hydrogen cracking. In several papers experimental studies were described to investigate these mechanisms. To date, the evidence is positive and suggests that the storage systems will continue to provide safety for extended time periods. These conclusions are supplemented by comprehensive programmes for the testing of metal and concrete casks involving tests to evaluate safety in scenarios involving normal operation, ageing, seismic events, and accidents (including an aircraft crash). Generally, the casks performed very well with little evidence of failures that would lead to significant safety issues.

There was recognition about the benefits of the Joint Convention; the process of exchange of information between countries promotes confidence and belief in other countries with respect to radioactive waste management. The international organizations are encouraged to continue and, if possible, to increase peer reviews and regulatory reviews. Together they provide evidence that countries are meeting their international safety obligations.

We need to emphasise that credible engineering solutions for disposal of long-lived radioactive waste are feasible and can be implemented in a manner that assures safety of people and environment. Public acceptance about radioactive waste and its disposal however remains an issue and would require political will for forward progress in tune with the expected growth in nuclear power programmes world wide. It must be recognized that a repository is necessary regardless of whether one opts for a closed or open fuel cycle. The issue of repository thus must be effectively addressed if nuclear energy is to be more generally accepted. While the experiences in countries vary, it seems to be generally accepted that public support for nuclear projects has to be obtained by building trust through openness and transparency, and more importantly by gaining respect through sustained credible performance. The trust building process may take some time to achieve. May be there is scope here for a well informed international technical view in respect of repositories. The involvement of local people in decisions related to the facility also helps. Similarly if local people can

be educated to understand the purpose and functioning of the facility, this will alleviate many of their concerns.

Climate change concerns, the availability of uranium and its price and the philosophy held with respect to sustainable disposal of spent fuel will determine the approach towards either the nuclear recycle route or the direct disposal route. It seems that while adoption of the nuclear recycle option in some countries will lead to the enhancement of the nuclear energy potential from uranium, in some other countries there will be growth in nuclear power capacity on the basis of the once through use of uranium. In either case, it is important that the road map with respect to management of spent fuel over its entire lifecycle is clearly defined and is being acted upon.

Experience in France has shown that nuclear cycle is cost competitive and leads to more energy with less waste. A global consensus, which does not exist at the moment, should lead to a more sustainable solution to the energy and climate crises that faces the world today.

Advances are taking place with respect to the higher burn-up of fuels, the development of fast reactors and advanced fuel cycles. These have been demonstrated on industrial scale. While this does bring in additional considerations with respect to the management of spent fuel storage, it seems that they can be accommodated within the available solutions.

Developments in nuclear power technology have enabled solutions to the question of meeting growing energy needs and we should expect growth in nuclear power development on the basis of these solutions. Research and development may enable further advances in the future. Most important among these is the possibility of reducing the radiotoxicity of radioactive waste to acceptable levels within a reasonable time period and bringing in greater proliferation resistance. There is urgency in realizing such solutions to overcome the remaining barriers to the growth of nuclear power world-wide.

Dear Friends, you will agree with me that this conference has enabled a comprehensive discussion on a wide range of issues related to the management of spent fuel from nuclear power reactors. The exchange of information and views expressed at this conference will enable different programmes around the world to benefit from the experience of others. More importantly, the discussions here should be of significant benefit to countries about to start their own nuclear programmes. The discussions have also provided a view of the current interests and directions being pursued by the Member States of the IAEA and will facilitate the shaping of IAEA activities in this area. Let us hope that, as we exploit nuclear energy for our use, we do not deprive future generations of their energy needs. Even more important is the aspect that we do not burden future generations with waste management problems that we could not solve.

Let me on your behalf and on my own behalf, once again thank the organizers for putting together this very useful conference. Thank you.