

# RECENT DEVELOPMENT ON RADIOLOGICAL PROTECTION AND RADIOACTIVE WASTE DISPOSAL

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Throughout the world there are numerous specialised conferences organised on radioactive waste. Why debate this subject at IRPA9 among radiation protection specialists ?

In the nineteen sixties and seventies, the aim was claimed to be the finding of a satisfactory technical option. It was the time when the advantages and drawbacks of each option were weighed carefully : shallow land and underground disposal, sea bed, and sea dumping, sending it into space, transmutation... The range of options progressively decreased as public awareness increased particularly regarding any form of disposal in the sea. Therefore, those in charge of waste management attempted to gain international consensus from experts to demonstrate that disposal was technically feasible and that long term safety could be assessed.

The most recent developments on the social and ethical dimensions are opening new perspectives on how properly take into account the interest of future generations.

Within this context, attention is particularly focused on the difficulty of applying to long-term waste management the principles of radiation protection as defined by the International Commission on Radiological Protection (1).

From whence does this difficulty arise ?

Schematically, the radiation protection system which is applied to « practices » in general requires that the source of radiation be under active control. Protection options (physical, institutional and operational) put into place just as much at the design stage as during operation of the corresponding installations are such that exposure levels can be kept below individual dose limits (limitation principle), and, for each source, below dose constraints corresponding to well managed operations (optimisation principle). Practices can even be prevented from being adopted if the disadvantages that could result from it outweigh the advantages (justification principle).

The protection system for practices must take into account both normal as well as potential exposure which are not certain to occur and could be the result of accidental departures from the planned operating conditions following internal or external events.

By analogy with the normal exposures, ICRP recommends for potential exposure compliance with risks limits and risk constraints. The two terms of the risk which must be considered in this case are the probability of an event which could lead to exposure, and the consequences of this exposure.

It is important to stress that, should the potential exposure really occur i.e. the source be no longer under control, it could be necessary to intervene (intervention situation).

For what concerns long term solid waste disposal, there are some specific aspects to be taken into account in applying the radioprotection system. These aspects makes it more complex to demonstrate that the source is under control :

- it is difficult to guarantee institutional monitoring beyond a certain number of years, thus active control of the source ceases. Yet monitoring is a key part of the system because it means application of the principles can be verified and makes it possible to intervene should control be lost.

- it is difficult to assess the exposure situations which correspond to normal or potential development of disposal situations because of the large degree of uncertainty involved, the complexity of the degradation process, the variety of possible events and the difficulties involved in assessing the environmental characteristics.

In 1985, the ICRP dedicated a specialised publication to the disposal of solid waste, ICRP46 (2). This states that during the long time periods of disposal two kind of scenarios of radionuclides release from the site has to be envisaged :

- a) normal scenarios involving the gradual degradation of the barriers leading to the slow migration of radioactive elements : these are scenarios which are very likely to come about ;
- b) probabilistic scenarios which correspond to processes or events which have constant or time varying probabilistic occurrence.

ICRP46 represented significant conceptual progress because it was the first publication by the Commission which extended the protection system to cover probabilistic situations and thus introduced the idea of potential exposure.

The introduction of this concept was both the result of ideas developed among ICRP experts as well as NEA and the IAEA experts from a broad range of situations, and at the same time was the beginning of the revision of the radiation protection system in light of this concept. As noted above, this concept is dealt with in the 1990 general recommendations of the ICRP (ICRP60) and is the subject of a specialised publication, the ICRP64 : Potential Exposure. A Framework. (3)

However, to the taste of some, the ICRP46, like many pioneering works, presents a too schematized view of the problem of waste. According to these critics, the emphasis is too heavily placed on the quantitative criteria which have to be respected, furthermore the aggregation of the terms of risk does not help the analytical approach to safety assessment.

One of the essential aspects not sufficiently pointed out in ICRP46 in applying the radiation protection system to solid long lived waste lies in the importance of the design phase, and the way in which all the various bits of information convince us that the long-term safety of disposal will be assured *The licensing issue of most concern is not what formal criteria should be, but rather how one can demonstrate compliance with a given set of criteria.* (4)

It is indeed essential to allow the authorities to make decisions based on precise regulatory requirements. These requirements should not be expressed in terms of probability or exposure levels which are likely to occur in the very long term. Everyone knows that complex models with numerous parameters can be implemented so as to reach a desired conclusion. Rather, the regulatory requirement need to be a technical one which should be chosen in such a way that they are easily checked.

As regards the development of the concept of potential exposure, particularly taking into account the debates which have brought together specialists in radiation protection, waste and safety in the context of the NEA and the IAEA, (5) (6) the emphasis is placed on :

- the distinction between individual and collective risk, the latter being more than merely the sum of individual risks,
- the drawbacks inherent to an over-aggregation of the various components of the risk, and to the consequent need to respect a criterion for design of the waste repository based on limitation of individual risks.

Recent work within INSAG has tended to show that if the exposure were actually to occur and give rise to levels of exposure higher than the 10 mSv - 100 mSv range, considerations in addition to that of simple individual risk would need to be taken into account. Indeed, the authorities would be expected to intervene, changing the scale of the problem. (7)

This reasoning, directly coming from the reflexion on the safety of installations, needs to be adapted to waste disposal as far as the potential over exposure of some individual does not result from the loss of active control

but from a voluntary or involuntary intrusion. Moreover, the accidental dispersion of activity in time and space, even at low level, could be considered.

In conclusion, we feel it is important to underline that, essentially, protection of the radioactive waste disposal systems is clearly defined by the principles of the ICRP. However, the numerous current debates must lead to the establishment of concrete ways to apply these principles, particularly for the benefit of the decision makers. This matter has taken on even greater importance since development has begun within the framework of the IAEA, of a convention on radioactive waste which must correspond to an international consensus, yet national regulations are still not in line with each other and correspond to more or less narrow interpretation of the ICRP's intentions.

At the light of this general considerations, and along the line of the conceptual framework established by the ICRP46, the ideas now being developed by waste specialists tend to explore or go deeper into the specific aspects of the problem and integrate with ideas on the following themes :

- to refine the considerations which relate to the ethical aspects of disposal of long-lived waste. This dimension must indeed be taken into consideration because we are transferring a risk to future generations who have not directly benefited from the activities which generated it, and who have not been able to have a say in the decisions which are being made today, or will be made later, on the disposal options. (8)
- to clarify the safety approach by identifying the different stages of this approach in such a way that the decision makers and the public may have « reasonable confidence » in the long term safety of the disposal system. One of the ways to clarify this matter is to divide the future into periods of time. Expressing an increasing degree of uncertainty the further away they are. To propose that the safety criteria be replaced with different « indicators » enabling the impact of disposal to be assessed. (4) (9) (10)
- to ensure that the management methods for the different categories of waste to be assessed are in line with each other high active and long-lived waste, low and medium active short-lived waste and waste from mining and milling of uranium and thorium bearing ores. The latter present particular difficulties due to their vast quantity, the specific radionuclides involved and to their extremely long life span. (11)

I thought it would be interesting to examine these different topics during the IRPA-9 seminar on waste management.

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« Radiation protection and radioactive waste management in the mining and mineral processing industries »