

PREPARING TO LICENSE DEEP DISPOSAL FACILITIES - THE INTERNATIONAL SCENE

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Research into the availability of deep, geological facilities for radioactive waste disposal is a very serious and extensive undertaking in many countries. It is also an activity in which there is a high degree of international cooperation and agreement. Before any disposal facility can be constructed, however, and before it can eventually be sealed up and left to function in the manner for which it was designed, it must go through the assessment procedures of the regulatory authorities in each country. It is interesting to examine the extent to which there is agreement in the approach being adopted by regulatory authorities to the licensing of such facilities.

At the present time there are no deep geological facilities anywhere in the world. There are, therefore, no licenses to examine to see what licensing procedures were used, but by looking at what is being done in individual countries, in the International Atomic Energy Agency and in the Nuclear Energy Agency it is possible to obtain an idea of the trends which are developing.

BASIC PRINCIPLES OF DISPOSAL

Behind all licensing actions there are the basic waste management principles which have been built up over the years by researchers, operators and regulators alike. A document examining and summarizing these concepts is at present being prepared by a working group of the NEA and should be ready by the end of the year. Two of the latest publications of the IAEA, Safety Series 53 and 54, set out similar results from workshops conducted over the last few years.

From the radiological point of view, the overall objective of the licensing process is to ensure that the wastes are disposed of in a manner which does not give rise to unacceptable detriments to humans now or in the future. Wastes are, by definition, materials for which there is no further use and disposal is, therefore, a method for getting rid of wastes without the intention of ever wanting to retrieve them. In addition to this, there is universal agreement that after a disposal facility has been closed it should not rely on institutional controls for its integrity. This explicit expression of concern for future generations is an aspect which tends to characterize the management of radioactive wastes and it stems from an extension in time of the principle that those who derive the most benefit from any activity should also bear most of the costs. It is generally agreed that, to the extent possible, any problems which are left to future generations should be no greater than those which would be acceptable to the present generation.

RADIATION PROTECTION PRINCIPLES

In addition to these philosophical concepts there are the principles of radiation protection which have evolved to ensure that when humans are exposed to ionizing radiation the risks are maintained at acceptable levels. With only minor exceptions, most countries accept the recommendations in this area of the International Commission on Radiological Protection. Its recommendations can be summarized as follows:

- no practice involving radiation shall be adopted unless its introduction produces a positive net benefit;
- all radiation exposures shall be kept as low

- as reasonably achievable, economic and social factors being taken into account; and
- the dose equivalent to individuals shall not exceed the appropriate dose limits.

The first of these is not directly applicable to waste disposal since the production of wastes is itself justified by the benefits obtained from the electrical production which gives rise to the wastes. The remaining principles, together with appropriate recognition of the need to control population doses, form the basis for the radiological assessment of all waste disposal methods. Their proper implementation calls for some form of cost-benefit analysis.

The regulatory process requires a suitable demonstration that radionuclides entering the biosphere from a waste disposal facility do so only at a rate which is consistent with the above principles.

SAFETY ANALYSIS

There is no disagreement on the manner in which such a demonstration can be made; it can only be done through the use of predictive modelling. Even though nuclear fuel wastes lose activity through radioactive decay and eventually reach very low levels, the time for this to occur is long enough that no practical demonstration, in the normal sense of the word, can be carried out. Models will therefore be used which are based on assessments of the mechanisms and pathways by which radionuclides may eventually move from the facility to the biosphere. Regulatory agencies must then, as a result of their own assessments of these models, be convinced that the predictions being made are acceptable.

A safety approach already favoured by regulatory agencies is that disposal facilities must be designed with defense in depth whereby there will be multiple barriers, either man-made or natural, to contain the wastes and restrict the movement of radionuclides. Guidelines have

already been formulated in several countries indicating the types of geological and hydrogeological settings, waste forms and backfill materials which might achieve the desired degree of containment.

ACCEPTANCE CRITERIA

It is generally agreed, and preliminary estimates indicate, that the actual dose arising from the disposal of spent fuel wastes will be extremely small and well below the maximum limits recommended by the ICRP. Facility performance, as shown by the safety assessment, will not therefore be judged against these maximum levels but against much lower target levels derived as a result of anticipated behaviour. It is the task of the national regulatory authorities to set these criteria and, in so doing, they will be initiating the process of determining what is reasonable in light of the ICRP recommendation that all doses be as low as reasonably achievable. The criteria will initially take the form of design targets for overall facility performance. As confidence is gained in the methods and models for assessing facility behaviour, and possibly after there have been modifications, they will eventually be used as acceptance criteria.

There are at least two different ways of setting these design/acceptance criteria and both are being considered. The first involves setting a value of dose for both individual and population exposures and then assessing the performance of the facility in relation to these limits. The levels would be set at some small fraction of, for example, the limits set by the ICRP. The main difficulty lies in being able to perform meaningful dose commitment calculations over long time periods. The other method is to take a comparative approach, thus overcoming the need to be definite with regard to population size. The facility can be judged according to whether the dose it contributes is an acceptably small fraction of that which could be obtained from background radiation. It is also possible to use

comparisons such as those based on the amount of ore from which the original uranium was obtained. There is still room for much discussion in this area, and it is too early to say which approach will prove to be the most widely accepted.

CONCEPT DEMONSTRATION

As was stated before, it will never be possible to demonstrate, through performance, the successful behaviour of a deep disposal facility, simply because of the time scale. However, there is evidence of a trend toward a special kind of demonstration involving an examination, not of an actual site destined to receive wastes, but of a

conceptual site embodying the range of properties likely to be encountered in real situations. This has arisen in different ways. In Finland, Sweden, Switzerland and Germany it has come through the legislative route where the continued use of nuclear power has been tied to the provision of assurances that permanent, safe disposal will be available. In the United States, a generic environmental impact analysis has been produced and in Canada the Atomic Energy Control Board has been asked to comment on a generic assessment before further site-specific investigations are undertaken. With the continued public and political interest in the disposal of spent fuel wastes, this trend could well become a permanent feature of regulatory procedures in the future.