

# Ways to dispose of radioactive waste

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**Geology and Radwaste.** By A.G. Milnes. Academic: 1985. Pp.328. Hbk £50, \$60; pbk £36.95, \$39.95.

EVENTS during the first months of 1986 have placed the nuclear industry in Britain at the centre of public attention. A series of minor incidents at the Sellafield nuclear fuel reprocessing plant, the identification of four possible sites for the shallow disposal of low-level radioactive waste, the publication of the Environment Select Committee's critical report on radioactive waste — all have been greeted with outcries from the various groups opposed to all forms of nuclear proliferation. Now, of course, we have had Chernobyl, and the attacks on the nuclear industry will intensify.

The consistent reply from the industry has been that its critics are over-reacting, that technical improvements will continue to be made and that the risks associated with release of nuclides into the environment are overstated. These differences of opinion will not be resolved easily, and will fuel the continuing debate on the sources, and disposal methods, of radioactive waste.

Such waste is traditionally subdivided into four classes: very low, low, intermediate and high-level/heat-generating. However, this classification can be over-simple in that short-lived, intermediate-level waste may be disposed of together with low-level waste, and some argue that  $\alpha$ -emitting low-level waste should be grouped with intermediate-level waste.

Because of the long half-lives of the radionuclides it contains, and the daughter products, high-level/heat-generating material will be an environmental hazard for hundreds of thousands of years. For this reason, disposal must be at depth in a geologically stable environment. A British research programme into deep disposal was stopped by the government in 1981, and for the next 50 years high-level waste will be stored on the surface as a fluid, and progressively encapsulated in glass, in order to maximize dissipation of the heat which is less easy to control underground. Deep disposal will then follow.

Since 1981 the responsibility for finding, proving and developing low- and intermediate-level waste disposal sites has rested with UK NIREX Ltd, a company controlled by the energy and nuclear industry. Selection of a deep site for intermediate-level waste in an anhydrite mine at Billingham led to local opposition, and then withdrawal of the site by the government. The choice of Elstow for an engineered low-level disposal site in clay met a similar reaction but, now, three further shallow sites in clay have been named; after detailed investigation, one of them will be selected and the case for development put to a public enquiry.

Against this background, the appearance of *Geology and Radwaste* is timely. Milnes defines his reasons for writing the book in the preface. He notes that the geological uncertainties are inherent, that simple solutions rarely exist and that this field offers much scope for conflict, as did the classic geological controversies of the past. Despite his conviction that the nuclear road is not the one we should take, he recognizes that here is a problem that will not go away, and that radioactive waste disposal is no more of an environmental hazard than the uncontrolled emission of (for example) carbon dioxide, sulphur dioxide and heavy metals.

The book is divided into three parts, the opening chapter of Part I providing a summary of radioactive waste types. As in

the remainder of the book, the text here is exceptionally clearly written and well illustrated, meeting the author's objective of being accessible to a wider audience than the specialists involved. Also notable is Milnes's impressive grasp of the literature; much that is published on this subject is unrefereed, and is available only in rather obscure reports and conference proceedings. Each chapter ends with a summary of selected literature, with full references at the back of the book.

The second chapter of Part I covers the alternative methods of disposal of low-level liquid wastes, and the disposal of low- and intermediate-level solid wastes at sea, by shallow burial and in deep, mined cavities. The particular problems of high-level waste are highlighted, attention being drawn to some of the more exotic solutions that have been offered in the past.

Part II, occupying about two-thirds of the text, gives the geological perspective to radioactive waste disposal by describing the subsurface and surface processes operating through geological time. Much of the material here is familiar, but the author skilfully draws in case histories and examples to illuminate particular points; for instance, rates of denudation are illustrated by reference to the Texas Panhandle and to a mine test site at Mol, in Belgium. The eleven chapters systematically cover the relevant rock-forming, tectonic, geomorphological and fluid processes which provide the potential environments for storage and disposal. These processes are discussed in the context of the time-scale within which hazardous disruption of a repository could occur.

The two final chapters review predictive methods for identifying the disposal system most likely to guarantee that any release to the environment will not exceed regulatory limits. Safety assessment of potential sites demands expertise well beyond geology, and the book does not provide a guide to methods of site selection, site specific investigation or the geological aspects of safety assessment. Within his chosen compass, however, Milnes has produced a lucid and thorough book which should be read by all of those who have involvement with, or interest in, the geological disposal of radioactive waste. In the aftermath of Chernobyl, that is likely to be very many people indeed. □

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• *Management of Toxic and Hazardous Wastes*, published by Lewis Inc., Chelsea, Michigan, contains the (updated) proceedings of a conference on the subject held in Columbus, Ohio, in 1983. Price is \$49.95, £45.95.

## New journals review



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