DISPOSAL OF NUCLEAR WASTE 'EVER MORE PRESSING'

Call for research into Synroc

*By BRIAN MARTIN

IN terms of total potency, radioactive waste from nuclear power plants today is already comparable with military wastes, since the power-plant wastes are nearly 100 times more concentrated.

Furthermore, it is planned that the inventory of power-reactor wastes will be perhaps 15 times as great as the military wastes by the year 2000. Therefore the permanent disposal of these wastes looms as an ever-more-pressing problem for the nuclear industry.

Recently a new method for the permanent disposal of high-level radioactive nuclear waste was developed by a team headed by Professor A. E. Ringwood, of the Australian National University.

It was first announced at a press conference on July 27, 1978. More recently (The Canberra Times, November 22) Professor Ringwood reports that he hopes that the Synroc disposal method will be cheaper than previously proposed methods as well as providing much greater security against escape of the wastes into the biosphere.

Although Synroc seems to be an advance over the previous methods, it still faces a number of obstacles, both technical and political.

The essence of the Synroc proposal is to embed the radioactive waste in a synthetic rock, the crystalline structures of which have a demonstrated natural ability to hold the elements found in radioactive waste in place for millions of years. It is proposed that the Synroc so formed will be encased in cannisters and buried deep underground in granite formations.

Although natural rock crystals have demonstrated that they can hold the elements in radioactive waste in place for millions of years, this does not guarantee that Synroc will do the same.

Firstly, Synroc contains a much higher percentage of the elements in radioactive waste than is found in natural rock. There have been no experimental tests of the long-term stability of rock crystals of the Synroc type.

Secondly, natural rocks for the most part contain impurity elements which are non-radioactive. Synroc will contain the radioactive varieties (isotopes) of these elements. It appears that Professor Ringwood and his colleagues have carried out tests only with uranium and with non-radioactive isotopes of the elements in radioactive waste. Therefore the physical changes in Synroc caused by radioactive decay over long periods of time remain to be determined.

Thirdly, natural rock is usually part of a large unified formation, whereas Synroc will be constructed only in relatively small portions and then placed in a granite formation the natural integrity of which has been breached by the deep hole drilled for the Synroc.

These points indicate that further research is required into the Synroc disposal method before any firm conclusions can be made about its geochemical and geological effectiveness. Professor Ringwood has said more than once that further studies are needed. Indeed, the fairly significant changes in the proposal since it was first announced suggest that the method is still in the research stage.

Reprocessing

Professor Ringwood's presentation of the Synroc-disposal method is based on the assumption that the spent fuel rods from nuclear power reactors will be reprocessed to remove most of the plutonium and uranium. This assumption of reprocessing is essential for the Synroc proposal, and it raises serious problems.

Firstly, there is, at present, no large-scale reprocessing of uranium oxide fuel anywhere in the world. If waste disposal is to depend on prior reprocessing, economics may make the entire process unfeasible.

A second problem with reprocessing is that a large fraction of the long-lived radioactive waste, such as plutonium, which is not recovered during reprocessing finds its way into low and intermediate-level waste rather than the high-level waste which is to be embedded in Synroc.

Low-level wastes are normally buried in trenches, and significant movements of wastes have been found at many sites. Much of the intermediate-level waste is dumped into the ocean. Hence any proposal which depends on reprocessing does not solve the problem of accumulating quantities of biologically dangerous long-lived radioactive wastes, a problem distinct from the one of the more concentrated high-level radioactive wastes.

Finally, reprocessing makes available vast amounts of chemically pure plutonium and hence is a strong encouragement for proliferation of nuclear weapons as well as to the activities of terrorists and criminals.

It is for these reasons that the US Government has a policy, supported for the time being by Australia, which discourages any moves to reprocess nuclear wastes. Professor Ringwood believes that proliferation of nuclear weapons is one of the most serious problems created by nuclear power, and it is ironic that his waste-disposal method depends on reprocessing which is such a strong contributor to the potential proliferation.

Originally it was estimated that Synroc disposal would cost three to four times as much as the prior alternatives of glassification or calcining and disposal in salt mines. However, more recently Professor Ringwood has claimed that Synroc might actually be cheaper than the alternatives.

The economics of waste disposal is important because the economics of the entire nuclear industry is at present in a precarious state, and decisions are as likely to be made on the basis of economics as of safety. Indeed, safety has often been sacrificed for economics in the history of the nuclear industry, as in the case of exemption of the industry from full-insurance coverage for reactor accidents, or the strong reluctance of uranium mining companies to return tailings to mining pits and so reduce the very low but very long term hazard from thorium in the tailings.

Because no details of the economics of Synroc disposal have been produced and because not even a pilot production plant exists, Professor Ringwood's hopes concerning the cheapness of Synroc remain unverified for the time being.

There is an enormous step involved in going from a theoretical proposal for waste disposal to an actual disposal operation. A viable disposal operation would have to be secure against mistakes; mistakes in collecting the radioactive wastes and in storing them until decay levels have declined, mistakes in synthesising Synroc, mistakes in choosing and drilling a disposal site and mistakes in filling and sealing the hole. These mistakes cannot be prevented through theoretical means, however ideal, since for the most part they arise from human error and lack of knowledge.

Furthermore, the inevitable limitations in human knowledge raise the question of whether any waste-disposal technique, even one apparently operating perfectly as planned, can be considered truly adequate. In the end, only knowledge available after the required 100,000 or one million years can tell whether the method has actually worked as planned.

How confident do we need to be in our knowledge before making the gamble — however excellent the odds — of claiming to have solved the waste disposal problem?

Professor Ringwood has pointed out severe limitations to the previously favoured disposal methods of glassification or calcining of the waste and disposal in salt mines. There has been an ongoing debate over whether these previously proposed methods were actually safe enough, with many lined up in favour of them and many, now including Professor Ringwood, opposed.

It seems to me that the presence of such a vigorous debate at high scientific levels indicates that the required knowledge and confidence in the safety of the methods is not yet sufficient to risk using them.

These previously proposed methods have been roundly proclaimed as safe by many advocates for over two decades.

Professor Ringwood's new attacks on them suggest that his own method will need to be scrutinised for a considerable length of time before any plans are made for actual implementation.

Professor Ringwood's principal conclusion is that "the problem of isolating high-level nuclear wastes from the biosphere can be solved". He does not claim that the problem has been solved nor even that it will be solved in the near future.

Keeping in mind both the technical and political limitations of the Synroc proposal, it seems that the conclusion of the Ranger Inquiry at least for the time being remains valid: "There is at present no generally accepted means by which high-level waste can be permanently isolated from the environment and remain safe for very long periods".

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