A. Gonin/CEA

Dessicators for the preparation of concrete samples, before they are placed on the Banco test bench (investigation of chloride migration) and the Bandy test bench (measurement of hydrogen diffusion through the lid of an ILW-LL waste container), at CEA's Marcoule Center.

II. NEW DESIGNS: THE PACKAGE AT THE CORE OF INVESTIGATIONS

The essential function fulfilled by the radioactive waste package is that of confining radioactivity, over the timescale for which it has been designed. It is thus necessary to ensure that this item can effectively carry this out, over several decades, or several centuries, for the storage case, and over several thousand years, or tens of thousand years, for geological disposal. Ascertaining the package's confinement capacity, and its evolution over time, is what is at stake, essentially, in investigations on long-term behavior. Their aim is not to *predict* the state of a given package, at some more or less distant time, but to provide the guarantee that that state will remain within definite bounds, for all foreseeable cases, as regards the evolution of the environment in which it is placed. Social acceptance, for modes of very-long-term management, may only be gained on the basis of public confidence as to the validity of these investigations.

Indeed, research workers have been able to draw up – with very large safety margins – operational models that take on board all of the elementary physical and chemical processes involved in package degradation over time, these being investigated in the laboratory, in real or accelerated time, along with their interactions in conditions representative of disposal (or storage) facilities. The relevance of these models is verified, over the longest timespans, on the basis, in particular, of observations carried out on natural, or archeological, analogons (e.g. volcanic glass or obsidian, or glass samples from the Roman era).

The life of a waste package invariably starts with an obligatory stage of storage, which may be carried out for more or less extended periods.

A survey of examples coming from other countries shows that, in spite of notable differences in terms of philosophy or practice, a consensus is emerging as to the necessity of ensuring disposal of ultimate waste, in all cases, whether it be waste yielded by the reprocessing of spent fuel, as in France, or spent fuel itself, as is being considered in some other countries. Disposal in deep geological formations, this being the solution most generally contemplated by nuclear countries (in forms involving varying degrees of reversibility), raises scientific issues, some of which come into the field of expertise of CEA research workers.

The other option would be that of storing, over extended timespans, long-lived, high-level waste or spent fuel, the latter being deemed to be waste, and kept as is. To evaluate the potentials, and constraints, of this option, research workers have sought to ascertain whether it would be feasible to extrapolate the performance of current industrial facilities, to extend their operational lifetime from a few tens of years to one, two or three hundred years.

Owing to the natural geological barrier, deep disposal is nevertheless seen, by experts, as the only solution having such inherent safety over time as not to require constant monitoring by society.