CONCLUSIONS AND PERSPECTIVES

The research pursued along the three lines of the 1991 law, separation and transmutation, deep geological disposal, conditioning and long term disposal, aim at proposing a number of solutions that can be used in part or as a whole in any strategy of high activity long-lived radioactive waste management. However, the CNE underlines that the disposal of a certain waste in deep geological formation will be, in its opinion, necessary, whatever the strategy chosen.

The progress in research on the three lines of the law made it possible to strengthen the favourable perspectives after many years of uncertainty, as far as the third line of the law is concerned (containers and intermediate storage). The Commission notes that the second line of the law (underground laboratories) and maybe in the long run the first line (transmutation) are being significantly delayed. The experimental programmes now demand the realization of heavy experimental facilities. The realization of such facilities raises problems of safety and radiological protection. Some of them have already been taken into account for a long time by the relevant authorities. Others will be new. Since the CNE has not the competence for it, they will have to be studied by the national Authority for safety and radiological protection.

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The scientific works on the separation problems are well under way. The technological feasibility of most of the separation processes should normally be acquired by 2006. However the CNE recommends that solutions for the management of separated products be studied with the industrials, in order to enable the public authorities to make decisions concerning the follow up. It will be possible to present an assessment of the research and perspectives in 2006.

Research on transmutation poses more complex problems. It is of the utmost importance because it is closely connected to the possibilities of reducing the radiological inventory of long-lived waste, opened by the 1991 law. It forms, both for the negotiators and the citizens, an important element of the agreement from that period and future debates. It is linked to a vision of a sustainable development of the fission nuclear path which could be accepted more easily by Society. Questioning part of this research would contribute to lessening the credibility of the whole effort.

First of all, questions remain on the effective availability of the PHENIX fast reactor, essential to carry out the irradiation campaigns planned in the transmutation experimental programme.

Secondly, the CNRS laboratories became widely involved and associated themselves to the CEA and FRAMATOME in order to help France in actively promoting a European collaboration on transmutation. A sub-critical reactor in particular, assisted by a particle accelerator (ADS), seems to be a good tool to efficiently transmute minor actinides separated from used fuel. The realization of an ADS demonstrator has been proposed by the Technical Working Group (TWG) in April 2001 headed by C. Rubbia. The MUSE and MEGAPIE projects carried out at a European level, represent a significant effort in that direction.

However, the low priority given to the « nuclear fission » field on a European scale means that, even if transmutation receives nearly 30 % of the funds in this field in the 6th PCRD, the amounts allocated are insufficient and postpone the terms of the project. The thought of realizing such a demonstrator within a world action attached to the United States AAA projects –as the CEA suggests- can certainly be defended, but we may question the future of this proposal, considering the uncertainties of the American involvement.

Therefore The CNE recommends to maintain the objective of the European approach. France should take a strong initiative to support the activity of those laboratories which committed themselves, and launch the detailed study of a demonstrator. For example, the IPHI programme of protons accelerator, an important element of this type of reactor, and which was, not so many years ago, the starting point of a remarkable first experience in Saclay, should gain increased support in the future. Finally the CNE wonders what the role of the CEA-ENEA TRADE project will be, as well as its position in the European approach that the CNE has always supported.

The assessment that will be presented in 2006 will have to be based particularly on the experiments carried out in PHENIX. It will have to include research carried out at a European level, centred on a project of hybrid system demonstrator dedicated to waste elimination.

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The inventory of the waste packages to be disposed of is a problem common to any disposal scenario. The CNE had pointed out the urgency of it. After the study of the inventory methodology entrusted to the President of ANDRA in 1999 and approved by the CNE in May 2000, the Government has decided to have the inventory start in June 2001. The first inventory is expected in 2004.

Research in an underground laboratory to acquire the necessary knowledge for future disposal in a geological environment, wherever it will be, have been delayed several times and at length. The

second line of the law represents a very important social challenge. Research on underground disposal is presently linked closely to the progress of the Bure laboratory. The level of progress of the main shaft in the underground work, presently interrupted following the tragic accident on 15th May 2002, and the daily drilling speed later observed, give rise to the greatest worries as far as the research schedule is concerned. The time necessary to reach the level of the experimental alcove, the making of this alcove, and the resumption of the drilling to reach the laboratory mark leads us to think that the bottom of the main shaft will be reached at best towards the end of the year 2003.

The first galleries will then have to be drilled in 2004 (which realization was initially planned from October 2002) in order to carry out the programmed experiments. In these conditions, about two years (2005 et 2006) would remain open to work in the galleries. We can anticipate that the geological observations on the presence and the possible role of faults or fractures could be done in that amount of time, as well as some observations and experiments connected to rock mechanics (in particular how formations are damaged by drilling, sealing conditions, etc.). On the other hand, experiments concerning fluid transfers and geochemistry (flow, diffusion, migration in clays, behaviour of radionucleides in geological formations) will only give preliminary results, having to be confirmed, at the end of 2006.

To compensate, the ANDRA could take the initiative for more substantial tests to be carried out from the recess in the main Bure shaft, if the safety conditions allow it. Which additional strategy could the ANDRA envisage to implement (for example : using the most elaborated oil-industry techniques to take, in Bure, new measures of parameters in new drillings; realizing additional experimental works in Mont Terri where clays are fairly similar to those in Bure) ?

Besides, the preliminary hydro-geological modelling realized by the ANDRA in the Dogger and the calcareous Oxfordian aquifers on each side of the argillite clearly show that data presently available on these aquifers in the Meuse-Haute-Marne area are insufficient, particularly in the Dogger which is only recognized on two points. Therefore the CNE recommends to make several hydro-geological drillings in that area, within the best time limits compatible with the authorization of the works, and that some of the best quality hydro-geological logging should be carried out

Another cause of worry concerning the second line of the law is the present absence of a second laboratory. Before anything else, we must remember that, if the law clearly demands a second laboratory, it does not impose the nature of the rock nor the simultaneousness of both works. So we could loosen the constraints which do not appear in the law, and not restrain the possibilities of setting up a second laboratory in granitic sites only.

The digital modelling of a permanent repository and of radionucleides behaviour, from the container until the possible return to the biosphere, is a vital element in the research on underground disposal.

Therefore a special chapter of the CNE report is devoted to it. Complex phenomena taken separately are being put in an equation and this at a good level ; but the integrating tool of these elements to simulate storage behaviour is presently absent. In order to gather the necessary resources, the ANDRA is planning to implement the ALLIANCES "simulation platform" together with the CEA. It has also initiated the creation of the shared research group MOMAS. Besides, ANDRA has presented a first simplified integrating exercise within the framework of the « ARGILE » 2001 file; there are still many simplifications and these appear sometimes to be arbitrary, the appropriate softwares are far from being ready. The main software used by ANDRA (PORFLOW) does not take realistically the geo-chemistry into account : behaviour of chemical forms, chemical balances between the transported forms and the rocks. This gap will have to filled. ANDRA must both acquire tools that are more powerful, available and usable immediately, and prepare for the future by intensifying its efforts on ALLIANCES.

On the other hand the ANDRA has not to date presented any results on the scenarios of altered or accidental evolution. The CNE has already shown that the modelling and simulation means, and the available competences appear to be still insufficient to describe a scenario of normal evolution. In this respect, the hypothesis that nothing will escape the containers before 10 000 years in the scenario of a normal evolution seems to be preliminary. The problem of quality assurance for the manufacturing of the containers remains to be solved.

The CNE has noted that the ANDRA has planned to later study the case of an initial failure of the containers. This will certainly increase the scientific credibility of the safety assessments.

The research assessment planned for 2006 on the second line of the law will have to be based on the results obtained in Bure in the field of tectonics (existence, importance and role of possible faults), of rock damage (which will be, as the ANDRA explained, a critical element) and of mining engineering. As for fluid transfers and migration of elements, it should include the realizations obtained in Mont-Terri and those from digital modelling.

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In its report No 7, the CNE expressed strong recommendations on conditioning and disposal, subject of the third line of the law. It considers that these studies depend on good engineering, for which deadlines and binding agreements are essential.

The containers' projects – first of all for the B waste and used fuel packages - and the commitments to present functional demonstrators in 2002, and real size containers in 2004, result from a CEA-EDF

agreement which makes this schedule credible. In order to avoid the risks of a possible re-conditioning, the CNE wishes that the continuity between storage and final disposal be ensured at least by "primary disposal packages". Ideally, the "storage packages" should have such characteristics that they could be acknowledged by the ANDRA to become "disposal packages". For this, ANDRA would have to present its « level 2 specifications » and that conclusions should be drawn in common by CEA and ANDRA. In spite of its requests, the CNE has not heard any presentations on the containers of C glass packages for disposal.

Storages « de facto » have been existing for a long time. The concept and the realization of a surface or sub-surface storage that meet the terms of the law and the present state of knowledge depend, once again, on good engineering. The commitments made by the CEA to present in 2002 one or two draft(s) and to take on the binding agreement in time to offer real choices in 2006 will require intermediate meetings.

B waste and used fuel which are on long term wait, are the first objectives of this research. Although B waste are by nature ultimate waste that justify final disposal, we will probably have to wait a few decades for such a facility to be available, which demands an appropriate storage.

Prolonged storage of used fuel that has not yet been reprocessed has a double aim : technical necessity of cooling and waiting for energy and environmental choices that will have to be made in France. In the case of used MOX fuels, the realistic duration of the storage would be about a century, even more for fuels of second or third generation, if they were to exist.

The storage of high-activity vitrified reprocessed waste (C waste) in La Hague appears to be a proven solution that benefits from an industrial watch on site and an easier surveillance. If the waiting duration of an appropriate reversible repository imposes a long-term storage, we will have to study if the latter can be developed on the spot, with the benefit of the experience of the facilities implemented in La Hague (E-EVSE) and in Holland (HABOG).

The criteria of simplicity, easy handling, workers' safety and protection of plants (human malevolent intrusion, fall of heavy tonnage plane, lesser effect of seismicity, etc) are essential. In this respect, the CNE renews its interest for sub-surface works (on hillside) as well as a possible co-localization of a storage site and a disposal site, which would reduce transports and would make the implementation of disposal reversibility easier, if one day it reveals itself necessary. The early realization of a sub-surface storage gallery, with container prototypes in it, will stimulate the mastery of engineering. Moreover, if it were situated on a suitable nuclear site accessible to the public, it would greatly help the population understand the problem.

The research assessment planned for 2006 on the third line of the law will have to present the results obtained in terms of engineering (containers and storage works), as well as the perspectives of long term storage for C waste and used fuels, or waiting for available storage for B waste.

The CNE has always examined the works planned by the 1991 law with the framework of radiological protection standards elaborated by the relevant authority. The audits it participated to during the year have not mentioned any new scientific elements concerning the biological phenomena involved. This subject is presently giving rise to many publications on tissue, cell and molecular biology, unfortunately rarely of French origin. The CNE questions itself on the contribution of these results. Is their scientific maturity sufficient to draw new bases from them concerning the norms established by the specialized international Commissions? Should we not reinforce the research carried out in order to solve the controversies concerning these norms?