

International conference on the geological disposal of radioactive wastes

Opening session, Monday 15 October 2007

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It is a great honour for me to open the session of presentations of national policies on the disposal of radioactive wastes with the example of the strategy followed in France.

I feel this is a form of acknowledgement of France's relative lead in this field, but I hasten to add that the legitimate pride of being in such a situation is accompanied by a strong sense of responsibility, as this relative lead is to be interpreted in the light of two factors :

- First, it is not illogical that a country that ventured, thirty-five years ago, to launch into the original approach of acquiring its energy independence by producing nuclear electricity, finds itself in a position of having to devise a coherent radioactive waste management strategy slightly before other countries that took the same direction later, or with a lesser level of intensity, for instance because they have other energy assets;
- Second, the French strategy has been inspired, in any case, by all the experiences undertaken abroad, and continues to be applied in a scientific research perspective open to all international cooperation; to say that France is in a lead position is not therefore to claim that it can give lessons, but that it wishes to let others know about its experience, to benefit in return from all the solutions that could be imagined elsewhere.

I will present the French situation as a representative of the French Parliament and, more specifically, as a member of the Parliamentary Office for Science and Technology Assessment (OPECST). This situation is quite symbolic of the essential mediatory role played by the French Parliament in France: at the end of the 1980s, the Government authorised an exploration campaign to find a geological zone suitable for the deep disposal of wastes: the French population reacted rather violently to this initiative, feeling left on the margins.

The Prime Minister of the time, Michel Rocard, put an end to the exploration campaign, and left it to Parliament to start in-depth consultations to clarify the situation; in this manner the deputy Christian Bataille was tasked, on behalf of the Parliamentary Office for Science and Technology Assessment, with handing in, in 1990, a report on the radioactive waste management strategy, and a little later, the Act of 30 December 1991, defined for a fifteen year period the research avenues of this field.

In France, parliamentary intervention, as an expression of representative democracy, therefore formed one of the fundamental manners of taking into account the society dimension of the radioactive waste treatment issue. I'll return to this point later.

I would like to finish these preliminary remarks by congratulating Nagra for having organised this conference at a time of renewed international interest in the production of nuclear electricity. Such an approach is doubly relevant:

- First, it is essential to emphasise that the setting up of a nuclear electricity production industry must also comprise a waste management structure downstream; it is important to show that, in this field, unlike what some opponents claim, operational solutions exist, even if it is still useful to pursue research, and exchange information internationally, to improve them;
- Then, it is of course necessary that the solution chosen in each country must be related to its production of radioactive wastes. Indeed, while knowledge and experience can be exchanged across borders, there are obvious limitations to the international circulation of radioactive wastes. In France, the Act of 28 June 2006 forcefully recalled the ban on the disposal of radioactive wastes from abroad. Cooperation between countries consists in mutually helping one another to find viable and responsible solutions, but in each of our territories.

Now that these fundamental points have been made, I propose to present the French approach to the geological disposal of radioactive wastes on the basis of three key concepts:

- 1) Geological disposal must fit into a broader strategy of radioactive waste management allowing their volume and activity to be reduced, and leaving the door open to possible future alternative technical solutions.
- 2) The credibility of the strategy followed is based at one and the same time on deep anchorage in scientific research, the display of a clear implementation schedule, and strict compliance with deadlines.
- 3) Social acceptability of the approach requires a very broad decision-taking process mobilising all the resources of representative democracy, consultative democracy and contributive democracy.

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I. Geological disposal must fit into a broader strategy of radioactive waste management allowing their volume and activity to be reduced, and leaving the door open to possible future alternative technical solutions

To begin with, I would like to demonstrate that geological disposal, to be fully effective, must fit into the framework of a broader strategy, integrating other waste management instruments, and above all a strategy open to long term technical evolution.

In effect, the implementation of future solutions that could arise from scientific progress difficult to foresee today must not be compromised by overly rigid present-day approaches.

The concern over having to set in place solutions viable in the medium term must not prevent us from believing in the fecundity of science.

I. A. - The waste management strategy must reduce their volume and activity

I. A. 1) Treatment-recycling decreases the volume of ultimate wastes

The French wastes disposal strategy integrates the prime need to reduce their volume and activity. Treatment-recycling is already operational today and allows the volume of ultimate wastes to be reduced.

In France, spent nuclear fuels are in effect reprocessed to recycle the energetic materials not used in the reactor. On leaving an EDF pressurised water reactor, spent uranium oxide fuel indeed keeps a large part of its unburnt energetic materials: 93% of uranium 238, 2% of uranium 235 and 1% of plutonium.

Using the treatment techniques of these fuels and especially separation of the various components, 96% of spent fuel can be recycled:

- Part of the treated uranium is re-enriched and recycled in the form of fuel for the nuclear reactors at the Cruas power plant;
- Plutonium is recycled in MOX fuel (mixed oxide of uranium and plutonium), currently used by 20 reactors in France out of 59.

Treatment-recycling therefore facilitates radioactive waste management:

With respect to the disposal as such of spent fuels, it leads to separating non-reusable radioactive wastes from the other components, which reduces by a factor of 5 the volume of ultimate wastes;

Another advantage of treatment-recycling is that by recovering and recycling

uranium and plutonium that are responsible for a large share of long term radiotoxicity, it reduces the radiotoxicity of wastes by a factor of 10.

All in all, the treatment cycle, which concerns 1200 tons of fuel per year, leads to a production of high-activity long-lived ultimate wastes of 110 cubic metres per year.

The stock in 2007 is around 2000 cubic metres, in other words a pool 100 metres long, 20 metres wide and a metre deep. It's rather as if, every year, this pool grew wider by one metre.

I. A. 2) The aim of separation-transmutation is to decrease their activity

The complementary prerequisite to the disposal of ultimate wastes, in addition to reducing their volume, is to reduce their activity.

This reduction in the activity of wastes is at the heart of research on separation-transmutation which forms the number 1 strand of the waste management strategy followed in France since 1991.

The **separation** of minor actinides (neptunium, americium, curium) has been demonstrated in the laboratory. Various long-lived fission products have also been separated (particularly iodine and cesium).

Separation on an industrial scale depends on the refurbishment of the La Hague reprocessing facilities in 2040.

The feasibility of **transmutation** has been demonstrated thanks to the experiments carried out with the Phenix fast reactor or transmutation performed in a pressurised water reactor.

To perform transmutation industrially, it will be necessary to have Generation IV fast reactors and/or accelerator driven subcritical (ADS) reactors

These reactors exist for the time being only at the concept stage. Their industrial start-up will take place around 2035. Taking account of the tests to be performed on their capacity to transmute large quantities of minor actinides, industrial scale transmutation should be operational in 2040 at the earliest.

After 2040, separation-transmutation should therefore allow the production of high-activity long-lived wastes to be limited:

- Second generation power stations, if so happens, will reach the end of their life around 2040;
- Third generation PWR power stations will operate and produce active ultimate wastes until the end of the 21st century;
- Transmutation will leave only wastes in the form of minor actinides with a half life of less than a thousand years.

Thanks to 'treatment-recycling' and 'separation-transmutation', the issue of geological disposal is therefore very significantly scaled down.

I. B. - Disposal must be devised as an element of an evolutive strategy

I. B. 1) France has made the choice of reversibility

Deep geological disposal obviously forms a strand of the French high-activity waste management strategy. But France has integrated it in an evolutive perspective, by highlighting the reversibility dimension.

As you know, the aim of disposal is to make an underground layer of rocks like clay, granite, salt or tuff play the role of a 'safe' for radioactive wastes.

The setting in place of such a disposal site obviously raises the issue of geographical choice, since a suitable geological layer must be found: I'll return to this point. But it also raises the issue of strategic positioning regarding the possible choice of reversibility.

France set itself a fifteen year period for research on reversibility or irreversibility. This was one of the major challenges of the Act of 30 December 1991 on research on radioactive waste management. It finally opted in 2006 for reversibility, this definitive decision being enshrined in law.

In effect, engineering studies have demonstrated that a reversible disposal centre can be designed where waste packages can be recovered over a long period.

Reversibility allows a long waiting period to be planned pending an economically viable scientific solution to eliminate high-activity wastes kept in the underground laboratory.

I. B. 2) Storage is an essential complementary instrument to disposal

The French waste management strategy also concerns long term storage. The research conducted since 1992 has indeed demonstrated that separation-transmutation, deep geological disposal, and long term storage, are three waste management methods for high-activity long-lived radioactive wastes which are not competing, but on the contrary complementary per se and over time.

Therefore, long term storage is essential to:

- Take charge of presently non-reprocessed spent fuels;
- Lend flexibility to management and choice between transmutation and reversible disposal.

Furthermore, if in the future the reversibility of disposal actions becomes possible, it will certainly be necessary to make use of intermediary storage for packages awaiting reprocessing.

II. The credibility of the strategy is based at one and the same time on deep anchorage in scientific research, the display of a clear implementation schedule, and strict compliance with deadlines

I'll now analyse how the strategy followed by France is credible by being based on two pillars:

- Strong anchorage in scientific research;
- Strict compliance with planned deadlines, as demonstrated by the completed fifteen year stage from the 1991 Act to the 2006 Act.

There is admittedly almost a paradox in wanting to combine scientific research and strict deadlines, since researchers are rather accustomed to operating with no set dates. But keeping a highly time- framed approach is essential for the credibility of the strategy.

II. A. - Deep anchorage of the strategy in scientific research

II. A. 1) Scientific goals set by the 1991 Act

The strands of the French strategy, as mentioned, are in fact research strands: we saw that for the issue of reversibility or irreversibility.

Research pathways were listed by the Act of 30 December 1991 as 3 strands: strand 1 on separation-transmutation; strand 2 on deep geological disposal; strand 3 on long term conditioning and long term storage.

One of the contributions of the Act of 28 June 2006 is to have broadened the field of research, as the 1991 Act concerned high-activity long-lived radioactive wastes, and the 2006 Act concerns other categories of radioactive wastes. However, the Act of 28 June 2006 has enshrined the anchorage of the French strategy around the same three research strands.

These Acts subject any decision to scientific advances. For instance, the 1991 Act stated: 'before 30 December 2006, the Government will send Parliament a global report evaluating this research, accompanied by a bill authorising, where applicable, the set-up of a centre for the disposal of high-level long-lived radioactive wastes and setting the system of easements and constraints relating to this centre.'

II. A. 2) The National Assessment Board (CNE) and monitoring by OPECST

To follow up research, a specific body was set up by the 1991 Act: the 'National Assessment Board', tasked with producing an annual assessment report.

Its members, all acclaimed scientists, or industrialists with great experience, are appointed half by the Government and half by Parliament.

After having been set up, this board gave full satisfaction with its 11 annual reports and its global assessment report at the end of the fifteen year research period that commenced in 1991.

This board was reformed by the 2006 Act, particularly to broaden the scope of its assessment work, and its renewal has been slightly accelerated so as to make it more concordant with research effectively conducted.

Personalities from the moral and political sciences field have been appointed to it so as to extend its assessment capacity to research on the social acceptability of the radioactive waste management strategy.

Three international experts are members of it, which illustrates France's concern not to isolate itself, quite the contrary, from experiences gained beyond its borders.

This committee's work is assessed by the Parliamentary Office for Science and Technology Assessment of which I have the honour of being a member, and for which I will have the opportunity to describe the important role in steering the French radioactive waste management strategy. This assessment takes the form of hearings following the handing of annual National Assessment Board reports

The National Assessment Board, a scientific assessment body, is therefore placed, via the Parliamentary Office, under the scrutiny of Parliament.

II. B. - *Strict compliance with a schedule*

II. B. 1) Deadlines laid down by the 2006 Act

Fitting into the same scientific framework as that laid down by the 1991 Act, the 2006 Act on the sustainable management of radioactive wastes and materials took note of the research results obtained and set target dates to accomplish the three research strands.

It should be noted that this approach followed the recommendations of the Parliamentary Office in its summary report of March 2005, and also that the adopted schedule is in keeping with that proposed by the Office.

Referring to strand 1 on separation-transmutation:

- The 2006 Act states the need to have in 2012 an assessment of the two possible reactor types for transmutation: accelerator driven subcritical (ADS) reactors, and 4th Generation reactors, especially fast reactors;
- The Act sets the date of 2020 for the start-up of a prototype 4th Generation reactor, in accordance with the programme Act of 13 July 2005 setting energy policy guidelines and in compliance with the statement given by the President of the Republic on 5 January 2006 in his wishes to the nation's active forces.

Referring to strand 2 on geological disposal, the 2006 Act:

- Limits studies to reversible deep disposal alone, as already seen;
- States, in addition, that studies must be finalised so that the application for a license to create the disposal site is processed in 2015 and the centre placed in operation in 2025.

Referring to strand 3 on storage, the 2006 Act states that the modification of existing facilities, or the construction of new facilities, must become possible by the 2015 horizon.

<p>II. B. 2) Scientific choices made since 1991</p>

The credibility of the strategy is based on the fact that the scientific objectives laid down to date by the 1991 Act have been achieved.

Referring to **strand 1**, we have already seen that separation and transmutation have been scientifically demonstrated.

Referring to **strand 2**, we have seen that the feasibility of reversibility is considered an acquired fact.

In addition, clay has been chosen as the most adapted structure in France for geological disposal. Granite has been ruled out owing to its propensity to fracture, which would make it necessary to spread disposal in several dozen impervious blocks.

ANDRA (National radioactive waste management agency) has accumulated many favourable results on the capacity of clay to confine radioactive wastes, thanks to its research conducted in the underground laboratories at Mol (Belgium) and Mont Terri (Switzerland) and also at Bure (Meuse) by drilling from the surface and by *in situ* studies in the chamber of the Meuse/Haute-Marne underground laboratory.

Bure Callovo-Oxfordian clay has favourable confinement properties, particularly because it has been demonstrated that the most mobile ions would not reach the top of the clay layer before 300,000 years.

Referring to **strand 3**, long term conditioning and storage on the surface, these are two fields where major progress has been recorded.

1) The volumes of high- or medium-activity wastes have been divided by 10 since 1992, particularly by the compacting of technological wastes and metallic fuel structures;

2) The durability of vitrified waste packages has been increased to over a hundred or so thousand years;

3) Long term storage techniques on the surface or sub-surface, designed to complete the present industrial storage with a lifespan of 50 years, already guarantee lifespans of around a century.

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Here is a map showing that the Bure underground laboratory, at the boundary between the Meuse and Haute-Marne departments, is 230 kilometres in a straight line from Paris, and approximately the same distance from Berne.

Here is a plan showing a geological cross-section of the Callovo-Oxfordian *safe* at Bure.

Insofar as the choice of the Callovo-Oxfordian layer is an acquired fact, reconnaissance is now aimed at identifying a restricted 30 sq. km. zone within the possible 250 sq. km. zone delimited by the regional tectonic structures and the hydrogeological conditions. This stage should be completed in 2009.

A second stage, from 2009 to 2012, is to lead to the choice, within the restricted zone, of one or several zones suitable for the disposal site.

III. Social acceptability of the approach requires a very broad decision-taking process mobilising all the resources of representative democracy, consultative democracy and contributive democracy

This last part explains the conditions of the social acceptability of the strategy.

In this field, the aim is to combine the need to reconcile the coherence of the approach, which supposes a certain unity of decision in the Government and

Parliament, with open dialogue with the population, and especially with the inhabitants of the zones concerned.

The aim is to obtain the broadest possible comprehension of the strategy followed so as to promote a climate of confidence.

In this respect, an entirely essential asset is the commitment of Parliament, and more specifically of the Parliamentary Office for Science and Technology Assessment, regarding the definition of goals and concerning the follow-up of implementation.

Alongside representative democracy, great emphasis must of course be placed on consultative democracy, and even on what can be called contributive democracy, in other words a targeting of public financial means towards the zones most directly concerned, in the name of national cohesion.

III. A. - The mainstay of representative democracy

III. A. 1) OPECST's pivotal role

Parliament's involvement in the management of radioactive wastes above all entails the preparation and follow-up work of the Parliamentary Office for Science and Technology Assessment, even if debates on bills of course form high points of the roll-out of the strategy.

The Office first became acquainted with the issue of radioactive wastes on the occasion of the first report by Christian BATAILLE in December 1990: this report presented a set of measures to take a fresh look at the way of tackling this dossier which was in a situation of deadlock at the time. These measures then formed the structure of the Act of 30 December 1991.

Afterwards, the Office granted special attention to following up the developments and research, producing six reports :

1992: Report on low-level radioactive wastes, by Jean-Yves LE DEAUT

1996: Report on research on high-level radioactive wastes: civil wastes, by Christian BATAILLE

1997: Report on research on high-level radioactive wastes: military wastes, by Christian BATAILLE

1999: Report on the back end of the nuclear fuel cycle, by Robert GALLEY and Christian BATAILLE

2000: Report on the impact of radioactive waste disposal facilities on public health and the environment, by Mme Michèle RIVASI

2001: Possibilities of long term storage of irradiated fuels, by Christian BATAILLE

The report of 15 March 2005 by Christian Bataille and myself was the Office's eighth

report on radioactive wastes.

This report answered a referral to the National Assembly Bureau by the four groups represented in Parliament - UMP, PS, UDF and PC – which emphasised the broad political support enjoyed by the approach followed since 1991, and also the confidence granted to the Office.

The report title summarised the entire situation: 'Looking after the longer term: a bill in 2006 on the sustainable management of radioactive wastes'.

'Looking after the longer term':

This expression recalls that the energy policy time horizon is the long term. It also recalls that nuclear power is an industry of long time periods: for the management of wastes and also for investment in the production tool and in the fuel cycle management system.

'A bill in 2006':

The 1991 Act had set a deadline after 15 years of research on the three strands; the aim was to take decisions on the three research strands and deal with their interconnection over time.

'A sustainable management of radioactive wastes':

It was necessary to integrate in the strategy the idea of technological progress promised by pursuit of the research effort; it was also necessary to obtain support from citizens, especially those living in the regions directly concerned.

A few words of presentation on the Office:

The Parliamentary Office is a permanent delegation, jointly operated by the National Assembly and the Senate, where parliamentarians from each assembly sit. The Office comprises 18 deputies and 18 senators, appointed by their political group, the number of representatives of each group being proportional to their strength in each assembly. The Parliamentary Office can have recourse, as and when required, to the competences of the members of a scientific board composed of 24 members.

The authorities of the Assemblies refer scientific or technological issues to the Parliamentary Office.

It is set up to address topics in a long term perspective in a manner allowing broad political support, if not a consensus, to be obtained.

The preparation of the March 2005 report formed a perfect example of the ways the Office works, since it was drafted on the basis of a very broad consultation:

Missions were conducted in 6 countries: Belgium, Finland, France, Germany, Sweden, Switzerland, United States – 180 persons were met on the spot. In France, 70 persons were met in research centres and facilities, or through private hearings.

The rapporteurs of course met the elected representatives concerned in the Haute-Marne, Meuse, and the Champagne-Ardenne and Lorraine regions.

III. A. 2) Importance granted to parliamentary decisions

Parliament intervened directly, as such, when the two Acts of 1991 and 2006 were passed, but it is laid down that it shall also be involved in the procedure to process the authorisation license to build a disposal centre.

In effect, this procedure provides for:

- A report by the Parliamentary Office;
- And above all, the passing of a bill laying down the conditions of reversibility.

The start-up of the underground laboratory cannot take place without a further parliamentary decision.

III. B. - Place given to consultative democracy

Consultative democracy takes two forms:

- Use of broad prior consultation;
- Participation in follow-up and disclosure bodies.

III. B. 1) Prior consultations

Prior consultations take place at two levels in the procedure to process the authorisation license to build a disposal centre:

- On the occasion of a prior public debate;
- During the public inquiry preparing the State Council decree.

III. B. 2) Disclosure and follow-up bodies

At least three disclosure and follow-up bodies address the start-up of the disposal site:

- The local disclosure and follow-up committee (CLIS) created specifically by the 1991 Act to accompany the setting in place of an underground laboratory;
- The local disclosure committee (CLI), a local body which must automatically be created around any basic nuclear facility, and therefore around a disposal centre, pursuant to the Act of 13 June 2006 on transparency and safety in the nuclear field;

- The high committee for transparency and information on nuclear safety (HCTISN), a national body set up by the same Act of 13 June 2006, and tasked by the Act of 28 June 2006 with periodically organising consultations and debates on the sustainable management of radioactive nuclear wastes and materials.

The slide show the composition and appointment method of the chairmen of these three bodies which include association delegates.

III. C. - Supporting local development

III. C. 1) Assignment of specific resources

On Parliament's initiative, local development and scientific and technological development of the territories where underground laboratories are sited receive specific support through public interest groups set up in each department concerned.

This support is based on specific resources, thanks to:

- The creation of an economic accompanying tax paid by nuclear operators;
- The creation of a technological dissemination tax also paid by nuclear operators;
- The obligation to produce specific results imposed on nuclear operators for their participation in local economic or scientific development. They must demonstrate this in an annual report.

III. C. 2) Intervention on quite a broad front

Specific support is organised, via the public interest group, to promote local development and scientific and technological development in the territories concerned.

The Act also provides for support for the dissemination of scientific and technological knowledge, which takes on specific symbolic importance since it underscores the inclusion of the radioactive waste management strategy in a scientific research effort.

A decree of February 2007 defined the beneficiary zone, that is called the 'proximity zone' in a quite generous manner so as to cover well the surrounding districts which are often little: Bure itself, at the centre of the site, has a population of under 100 inhabitants.