ECONOMIC APPRAISAL OF DEPLOYMENT SCHEDULES FOR HIGH LEVEL RADIOACTIVE WASTE REPOSITORY IN FRANCE

Phuong Hoai Linh DOAN, I-tésé/DAS/CEA Saclay, Phone : +33 1 69 08 50 46, Email : phuong-hoai-linh.doan@cea.fr
Thierry DUQUESNOY, CEA Saclay, Phone : +33 1 69 08 55 94, Email : thierry.duquesnoy@cea.fr
Jean-Guy DEVEZEAUX DE LAVERGNE, CEA Saclay, Phone : +33 1 69 08 64 91, Email : jean-guy.devezeaux@cea.fr

Overview

Nuclear energy has been considered as the major electricity source in many countries since decades; however, discussions are still going on about what to do with the radioactive waste produced by the nuclear fuel cycle. In France, the least hazardous waste categories (low and intermediate level of short lived radionuclides), occupying about 90% of the radioactive waste volume, are already safely managed in near-surface repositories. Nevertheless, the remaining with most active and dangerous components (high level waste (HLW) and long-lived intermediate level waste (LL-ILW)) lacks of a definitive management option. France has undertaken research to find an optimal solution in terms of safety, environmental impacts and future generation burden minimizing, and the deep geological repository (DGR) is the predominant option, as it is defined as "the reference" by law.

France is one of countries having most important advances in disposal program with the potential of opening a DGR in the next decade (similarly to Finland, Sweden); the disposal opening process and schedule was fixed by the 2006 law about the radioactive waste management. This law decided a "quick" disposal implementation. In principle, this choice of the French Parliament has been decided in order to solve a problem of significant importance for the society, and thus to increase the welfare of the French citizens.

However, from a "purely" economic point of view, the long-term interim storage of HLW appears more favorable than the deep geological repository. The choice of having a quick disposal is therefore based on political and social reasons rather than economic criteria. The government's priority is not to minimize (ie decrease as much as possible) the cost of long-lived waste management, but to set up a definitive solution rapidly to relieve future generations of the burden of managing the radioactive waste. The rapid demonstration and implementation of the HLW management solution is considered to have higher value than the optimization of waste management costs. Furthermore, a quick DGR implementation would facilitate the nuclear renewal decision in France.

The main purpose of this article is to evaluate the optimal timing for the French HLW disposal solution and to determine our willingness to pay a higher cost to reach our objective: rapid disposal. This analysis may help French decision-makers in managing the DGR construction and commissioning schedules.

Methods

As quoted above, the choice of the French Parliament for a rapid disposal is going to increase the welfare of the French citizen. Economists often measure such a gain in global welfare by using a utility function which is quantifiable in monetary terms (i.e. in euros). We have built such a utility function integrating at maximum the economically quantifiable impacts:

- Main technical costs (e.g. storage, disposal, R&D),
- Main benefits (e.g. technology patent sale),
- Option of maintaining the nuclear option (due to better social acceptance for nuclear development induced by the disposal implementation),
- Consequences of a possible accident during the storage or the operation phase of the repository.

The main objective of this paper is to analyse the global utility of the DGR project through quantifiable parameters and to observe its sensitivity according to different DGR deployment schedules. Moreover, given a long-timescale project, we always introduce a discount rate in the analysis. According to the uncertainty level on the long-term economic growth (low, medium or high uncertainty), we have proposed three possible evolutions of the discount rate. They all decrease over time but at different speeds.

Obviously, economics is not the only or even the principal factor affecting decisions concerning the DGR schedule. However, economics is not unimportant, particularly in the nuclear industry, which faces an increasingly competitive environment. At a minimum, if the "quick" DGR implementation decided by the French government is being done to

achieve other objectives than economical ones, it is still worthwhile to know how much they are willing to pay for those objectives.

Results

- First, taking into account the costs and profits in gross values, the utility function will decrease if the DGR implementation is postponed. This result is in fact well in accordance with the time schedule described in the 2006 act, for a quick disposal. However, with "usual" discount rates (≥1%), the utility function is increasing according to the DGR delay duration.
- Second, the delaying of the industrial pilot phase (designed for testing the DGR feasibility) would decrease the DGR utility because of the risk of an induced diminution of the social acceptance in the nuclear power. It would be therefore preferable to maintain, as planned, at least the industrial pilot phase implementation for keeping the nuclear energy option. After that, our results show that there would always be an economic interest in postponing the normal operational phase of the deep disposal.
- Third, the DGR utility depends on the uncertainty level on long term economy.

Conclusions

If we consider only storage and disposal costs, it always appears more economically favourable to extend the interim storage than to dispose of the waste immediately. This remark remains valid even when taking into account also accident costs and gain from the technology patent sale. However, in France, the quick repository implementation is probably an indispensable condition for maintaining the nuclear development. Indeed, supposing that in case of disposal implementation shifting, the lack of trust in the radioactive waste management would lead to a strong nuclear opposition, old French nuclear power plants would be replaced by renewable energy which will most probably remain more expensive than the nuclear at least for the next 20 years (when including all the system costs). In this situation, the electricity cost increase will far exceed the gain due to the disposal shifting. Therefore, at least the “industrial pilot phase”, already defined for progressive implementation and for testing the disposal feasibility, needs to be implemented as scheduled to contribute to maintain the nuclear option.

After the pilot phase, the question of the normal phase schedule can be discussed. Depending on the uncertainty level on long-term growth rate, the shifting of the DGR normal operational phase could be beneficial or not. With low uncertainty level on the long-term economy, we still have a certain economical interest in delaying the disposal normal phase. However, the more the distant future is uncertain, the more we should maintain the efforts for completing a quick disposal.

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